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Adjusting Equipment Policies To Current Conditions

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Editor, American Machinist

During the downward stage of the depression, equipment policies, where any existed, have been adjusted to the vanishing point. As industry starts up the recovery incline one of its most important tasks is the restoration of the successful ones, and establishment of sound ones where none exist

WHEN this subject was selected by the committee on arrangements for this meeting I suspect they had in mind the conditions that prevailed during the first half of this year. As most of us know only too well, these conditions were conducive of black despair on the part of a good many men who should have known better. I am not referring to the millions who lost their jobs. Most of them showed far more courage than many an employer who was personally secure although worried over the prospects for his business.

Fortunately, evidences that the tide has turned are multiplying and we can therefore consider adjustments of policy to a condition that is radically different from that of even three months ago. Before doing that suppose we review what happened during the previous two years. I think it will give us a clearer idea of what will have to be done in the immediate future.

Adjustment is hardly the word to apply to what happened to the few really logical and constructive equipment policies that existed in 1929. Unless adjustment is the expression you use in referring to your change of pace when you suddenly discover an angry bull bearing down on you with head down and tail up. I submit that the adjustment in such a case is ten per cent conservative caution but ninety per cent sheer fright. And that is just about what happened to equipment policies. Let me quote a few actual instances.

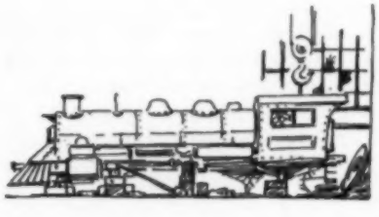
Suppose we start with the automobile industry because its equipment and methods are supposed to be so far ahead of those of other and older branches of metal working. As a matter of fact they are ahead but even so they leave something to be desired. One of the older companies making a high priced car has an announced policy of spending not one unnecessary cent for maintenance of equipment. When a machine in the production line breaks down they look it over to see if it can be repaired for under two hundred dollars. If not, out it comes and they make a trip to the surplus machinery storehouse to see what there is that can be tinkered up inexpensively to plug the gap.

One of the big body companies has followed the policy of careful attention to maintenance where safety is involved, and of letting everything else go.

Another automobile company, building low-priced cars, has a current policy of liberality toward repairs but prohibition so far as new machinery is concerned. In desperation the superintendent ordered practically complete sets of parts for two machines that he could not get along without, and assembled them himself. There is nothing novel about this performance, it has been done for years by railroad men who were up against the same stupid executive policy. And how it does waste money!

Speaking of railroad policies, let's see what is happening in that much-regulated field. We read about the surplus motive power, stored ready for use when the tide of carloadings rises. But will it be ready? I know of one case where

An address delivered before a joint luncheon of the American Society of Mechanical Engineers and the Society of Automotive Engineers at Buffalo, N. Y., Oct. 3, 1932.

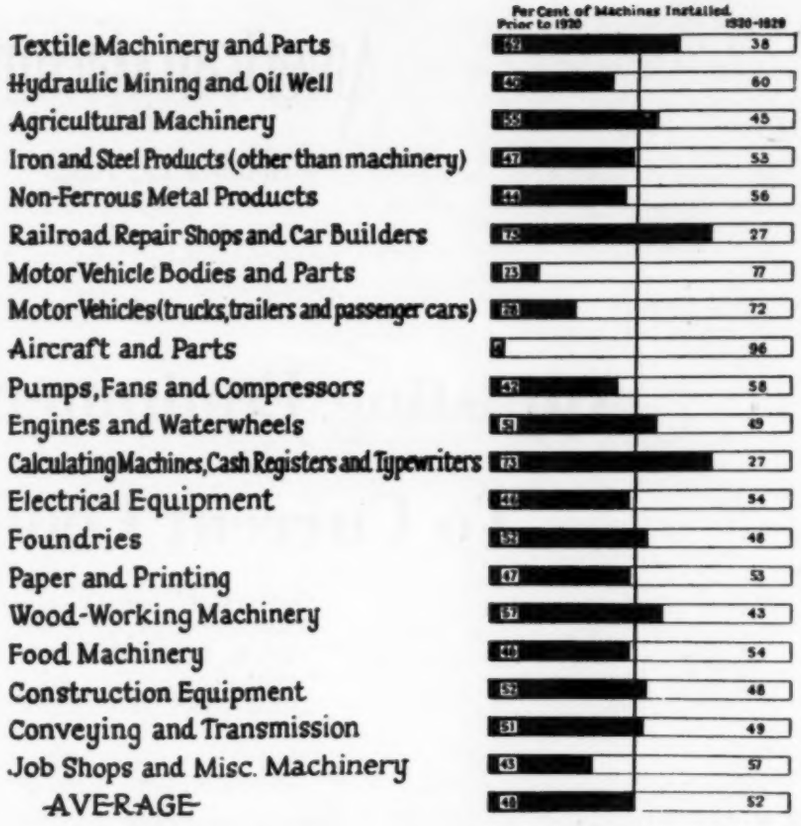


a relatively modern locomotive was given a complete overhaul and then ordered to storage. Three months later, when it was ordered out, it didn't even have wheels under it. Almost everything readily detachable had been borrowed for emergency repairs on line locomotives.

Somewhat the same fate overtook a radial drill in a mid-western railroad shop. A careless crane operator ran into it one day and removed its immediate usefulness as an accurate metal-working machine. The builder offered to put it in shape for a thousand dollars but the railroad people decided that it would be better to postpone action. Today it would cost as much as the price of a new radial to put that one in shape. Being one of a battery it has been denuded of its fittings and attachments until little but the column and arm are left.

But there is hope, even for the railroads. One railroad president has announced that one-third of his rolling stock and motive power will never be repaired, that it is scrap and will be treated as such. If only his competitors would take the same sensible stand there would be real hope for the future of the railroads, even with I.C.C. regulation and Congressional meddling.

Railroads and automobile companies are not the only sufferers from depression psychology. A steel company asked for bids on the repair of twenty wire drawing chucks that were pretty well battered. The shop that got the order bid $35 apiece. Its manager was conscientious enough, however, to point out to the steel mill superintendent that he could get new and better chucks at $45. His answer was that his board of directors, on which were several bankers, had issued an edict that not a cent could be spent for new equipment, but that he had a blanket requisition to get those chucks repaired and that the contractor had better go ahead and make a profit while he could. He did.



In 1930 *American Machinist* surveyed obsolescence in the metal-working industry. This chart shows the percentage of equipment over 10 years old in major divisions

Caution in New England

Another manifestation of the banker's aversion to spending money for equipment regardless of the economic advantage of so doing came to my attention a few weeks ago in New England. A boring mill was being figured on. The new one would save its cost in four years, even at the current low rate of activity, which I submit is pretty good for so large a unit. The president of the company which needed it was also a bank president, unfortunately. He vetoed the requisition because it was against his fundamental principles.

I think it is only fair to say, however, that the average banker has acquitted himself very creditably in this depression. Four months ago I sent out letters to leading machinery men in twelve industrial centers asking them what the attitude of their local bankers has been toward requests for legitimate business loans. With but one exception the answers were unanimous in the opinion that these bankers were doing all that could be expected of them.

Bad as has been the effect of panic on equipment replacement programs, there has been a more dangerous if less noticeable effect on the morale of production executives. A typical example will prove the point. It was told to me by a New York machinery dealer.

For five months this dealer has been working with the production men of a large machinery organization on a deal for three special machine tools. The order was finally signed and sent up to the financial heads for approval. It was rejected. The dealer was naturally much disappointed but he did not give up without a fight. With the entire approval of the production men he took the case to the financial heads. There he made his argument on the ground that the $60,000 involved in this order meant real unemployment relief because the machines had to be designed before they could be built. His argument scored for he was told that if the production men were convinced that the three units would make a real saving in production costs the order would be signed.

Two weeks later he got word that the production men had reported that they could get along without them. What had happened? Just this. These men had suffered four salary cuts. They had been pounded for months with the demand for more and more economies. The sin of spending for new machinery had been dinned into their ears. It looked more important to them to hold their jobs than to risk them by going against their superiors even though the company would profit thereby. I don't think it is necessary to dwell further on the danger inherent in this particular situation.

From the foregoing it would seem evident that equipment policies have been adjusted to the vanishing point during the painful period from October, 1929 to October, 1932. What is to happen to them now?

Assuming that we are two or three months along the road to recovery, a fair assumption all things considered, those companies that had successful

equipment policies will be thinking about adjusting them back to normal. Those that never had any will do well to study the successful plans and work out ones that will meet their own needs. I shall not attempt to go into details of such plans but shall mention a very simple one that may well be taken as a point from which to start. It is the plan of retiring ten per cent of the production equipment in the plant each year.

Good Even in Depression

Companies that had followed this plan for a reasonable period before 1929 found themselves in excellent shape to weather a storm. They could even abandon it altogether for the emergency and still be in far better shape than their competitors. I was talking with the operator of one such plan about a month ago. He admitted frankly that he had had to drop it during the last eighteen months, but his comment was just what I have remarked. He was able to do what work he had on thoroughly modern machines and at minimum cost. He observed that there was not a tool in his milling and turning departments that was built before 1925. Two years ago the average age of all his equipment was about six years. Compare that with the average for the industry. According to the *American Machinist* survey of obsolete equipment conducted in 1930, 48 per cent was more than ten years old. The average life, therefore, was somewhere near twenty years. Today it is certainly more than 22 years because so little equipment has been purchased since 1930.

Virgil Jordan, economist of the *Business Week*, estimates that the deferred purchases of production equipment of all kinds, metal-working, power plant, textile, food, leather, woodworking, and so forth, reaches the staggering sum of over thirty billion dollars. At the normal rate of annual purchasing, something like four billion dollars worth a year, it would take nearly eight years to make up the deficit. And to that you would have to add the amount necessary to keep current equipment up to date during that period.

With such a situation to face there is no question but that intelligent, farsighted equipment policies must be worked out and put into effect by American industry. This, to my mind, is one of the major problems which the Robertson Industrial Rehabilitation Committee must meet. A prodigious amount of educational work lies ahead and the engineering profession should see in it both a responsibility and an opportunity.

Back of any equipment policy must lie adequate resources. The best policy in the world gets exactly nowhere if the directors can take the equipment reserves and mistake them for divisible surplus. It has been suggested that such reserves be trusteed. Perhaps that is the answer but some of us don't feel quite so trustful of trust companies after what has happened to some of them recently.

In our present situation funds for replacement equipment are going to be difficult to find. The larger companies can finance replacements whenever they feel that it is safe to risk some of the precious liquidity of condition that has been the creed of the creditor bankers these many months. For smaller manufacturers the solution may be a machinery credit pool or financing organization something like the Railroad Equipment Finance Corporation recently formed. F. A. Geier, president of the Cincinnati Milling Machine Company, has been advocating such a corporation for at least two years. That again is a question to which the Robertson Committee will be asked to find an answer.

I am hopeful that eventually enlightened self-interest will take the place of the stupid selfishness that has characterized equipment buying for so many years. Let me explain that. It has long been the practice of the purchasing agent to beat down the price of the equipment seller by any means at his command. Just so long as the seller has no fixed price, and the purchasing agent knows it, there is nothing else for him to do. That's his job.

Machinery Men Must Eat

But if this process is carried to its ultimate conclusion the buyer will eventually cut himself off from the source of supply of the ingenious mechanical designing that has made American industry. The machinery builder and his engineers managed to get along on very little but they must eat. And if the machinery people are to have purchasing power so that they may exercise their function as consumers they must make some profit on their efforts. Else how can they buy automobiles, or shoes, or runless stockings, or whatever it is that the buyer of their machinery makes? Enlightened selfishness would take this factor into consideration while negotiating an equipment purchase.

The salesman is convinced that the greatest joy in the life of a purchasing agent is to beat down a price. Yet several important purchasing agents have told me that they would much prefer to deal with sellers who maintained firm prices for all comers. Unquestionably their routine work would be greatly simplified and they would

Value of New Industrial Machinery, Equipment, and Plant Facilities Purchased in the United States

(Millions of Dollars)

	Average 1919-1929	1929	1930	1931	1932	Average 1930-1932	% Decline: Average 1930-32 under 1919-29	% Decline: 1932 under average 1919-29
Industrial Machinery	1,924	2,098	1,573	944	524	1,014	47.3	72.7
Business and Office Machinery	175	187	112	78	56	82	53.1	68.0
Miscellaneous Industrial Equipment	587	844	633	380	211	408	30.5	64.0
Small Tools	551	627	470	282	157	303	45.0	71.5
Commercial Trucks and Motors	379	506	375	273	167	272	28.2	56.0
Cars, Railway, Traction, Industrial	436	321	289	32	10	110	74.8	97.8
Total Machinery and Equipment	4,052	4,583	3,452	1,989	1,125	2,189	46.0	72.2
Industrial Construction	801	1,177	1,038	453	135	542	32.3	83.2
TOTAL	4,853	5,760	4,490	2,442	1,260	2,731	43.7	74.0

Estimates of purchases of production equipment in recent years. This table appeared in *Business Week*, August 17, 1932. Note the appalling percentage drops in the last column

have more time for the constructive activities that should be part of every purchasing agent's duties.

And then there is the trade-in evil. It is universal. I am addicted to it myself, and I have bragged about trading in an ancient automobile on a modern radio set. I'm not sure yet who got the best of that bargain, but I'm not convinced that I did.

Selfishness calls for extracting the last nickel in allowance from the poor devil who is trying to sell you a new piece of equipment. Self-interest considers how that trade-in may be fixed up and sold to a shoestring competitor with no overhead and no price ethics, and what may happen to one's own market. If I were called on to pass upon an application for a loan to finance an equipment purchase, I should be inclined to insist that no loan would be forthcoming unless the equipment to be replaced were scrapped. I could even devise impressive ceremonies for the occasion, something like the ones some of the street car people staged when new cars were finally bought to replace the relics, or like the ones put on by the bus people when they drive the electric car into oblivion.

There is just one more factor in the equipment policy equation that I want to mention, and that is the human factor. Most of our manufacturers are no longer able to replace men with machines and give no thought to what will become of the men. They don't always know what to do about the men but they at least worry about them. One scheme that seems to have some merit is the one adopted recently by New York needle trade employers. New machines replaced men and made considerable savings. Part of these savings were put into a fund to tide the displaced men over until they could reestablish themselves as wage earners. This plan may not work in other places but it is indicative of a state of mind that holds hope for the future.

In the long run the new machine brings more employment at better wages and shorter hours but during the transition it may cause suffering, and that we must take steps to prevent.

Shorter Work Periods

And, speaking of shorter hours, our new equipment policy must not overlook a quite impressive change in the general attitude toward the length of the working day and the working week. Five years ago the five-day week was a radical dream and employers looked askance at any one who suggested it. Today they are talking unconcernedly of six-hour days and five-day weeks, of 40-hour weeks and even 30-hour weeks.

When the pendulum swings in this country it swings far. It is therefore not beyond the bounds of reason to expect compulsory legislation for a very much shorter work period than that to which we have been accustomed. To do any good toward relieving unemployment it will not do for some manufacturers to shorten hours while others do not. That would be manifestly unfair to those who take the progressive position.

It seems inevitable that the average factory worker will work shorter hours and at a higher rate per hour. Two or more shifts will be the rule in many industries. Two, at least, have already found it profitable to work four shifts.

Under these new conditions only up-to-date equipment will permit of profitable operation for the manufacturer. In planning his equipment policy he must therefore be prepared for conditions quite foreign to his old experience. And that policy should be adjusted to conditions as they change. A rigid equipment policy is quite as untenable as an unchangeable standard. But any kind of an equipment policy except one of complete stagnation is better than no policy at all. In fact, the establishment of a policy is one of the essential elements of successful management and of profitable operation.

Lubrication in Cold Drawing Sheet Steel

H. A. MONTGOMERY

President, the H. A. Montgomery Company

What a lubricant must do, what qualities it must possess to meet these requirements and what we still have to learn

EFFICIENT lubrication of production operations will effect a greater net saving to the average stamping plant than any other single factor, aside from correct tool design and construction.

Of the natural fats and oils sometimes used as sheet-metal lubricants, those of outstanding merit are beef tallow, wool grease, lard oil, caster oil and elaine oil. Of the compounded lubricants, widely furnished for this purpose, most of them will be found to be based principally upon the aforementionel fatty oils and fats, and with few exceptions, are all prepared in the form of water-soluble emulsions, varying gradually from solid pasty materials to viscous liquids. Such prepared compounds contain not only basic fatty lubricating material but also varying quantities of mineral oils, usually ranging between 200 and 700 viscosity.

The principles involved in the lubricating of metal drawing operations have little in common with the principles involved in machine lubrication. The first and foremost requirement of a good cold drawing lubricant is high film strength, but it by no means follows that any lubricant, possessed of this characteristic, is an efficient medium for the purpose.

Physical research has shown that a satisfactory lubricant must be properly balanced, principally as to coefficient of friction and surface tension. The apparent proper range of coefficient of friction, in accordance with physical research, is from 0.005 to 0.020. Surface tension in all instances should be as low as it is possible to obtain in any given lubricant. The factor of surface tension appears to be of the utmost importance, and those lubricants, seemingly possessing the lowest surface tension, generally speaking, function most efficiently.

It has been found by long experience that certain lubricating materials, derived from fatty sources, possess inherent characteristics which seem to be lacking in lubricants derived from mineral sources. These properties, when developed by chemical treatment, are greatly enhanced in value as lubricants for this use.

We do not find lubricating mediums of natural occurrence satisfactorily answering the requirements of stamping plant usage. It is only by chemical process of compounding that we finally arrive at a balanced condition in a lubricating com-

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Next in order of importance to die design and construction is the matter of correct lubrication

pound which fits the lubricating substance scientifically to the operation. In the preparation of lubricants for general stamping plant use, certain physical conditions must be developed; dependent upon the perfection attained rests the merit or efficiency of the finished compound. The conditions referred to are as follows:

1. Highest possible film strength
2. Medium coefficient of friction
3. Lowest surface tension
4. Fixed solubility in alkaline and non-alkaline water
5. Oil solubility
6. Stability of the product
7. Toxic effect upon workmen
8. Proof against fermentation, decomposition or other chemical change
9. Proof against corrosion
10. Ease of application
11. Ease of admixing
12. Ease of cleaning
13. Odor and general cleanliness of use.

The principal function of a cold drawing lubricant is to prevent scoring of the work-piece or breakage of the metal during the drawing operations, as well as the prevention of excessive die wear. Under the high pressures developed in cold drawing and pressing operations, the film strength of the oily medium is usually exceeded, especially in the case of heavy-duty work. When the lubricant film is ruptured, seizure of metal is likely to occur.

It is a physical impossibility to reach the required film strength of a drawing lubricant with any purely oily medium, saponified or unsaponified. It becomes necessary, therefore, to fortify the film strength of the oily medium with materials of a naturally tougher nature. This is usually accomplished by the addition of solid lubricating materials, in a finely divided condition, to the oily body of the lubricant, and the suspension of the same uniformly throughout the mass. These solids must be chemically inert and must also possess natural lubricating properties. Their function is to aid in preventing metal to metal contact. The amount of these materials that may be used is limited because of the difficulty its presence imparts to the subsequent cleaning operations. They are not particularly effective in fortifying the film strength of the lubricant if used in lesser quantities than 20 per cent, and seldom form more than 35 per cent of the entire formula.

It is well to point out that, so long as more or less indestructible solid material is introduced between the metal of the work-piece and the die wall, a definite separation of metal to metal is maintained, and the chances of scoring are greatly reduced. Solid lubricating materials added to the oily medium of a drawing lubricant are usually possessed of a high degree of oil absorption, and because of this, are effective in carrying a definite portion of the oily medium directly between the metal of the work-piece and the die wall. The pressures exerted during the drawing operation express the oily medium from the solid material, thereby maintaining some of the actual lubricating substance at a point where it is most required.

Generally speaking, the solid added to drawing lubricants is a neutral calcium carbonate. There are other substances which may be added, such as lead carbonate, zinc oxide, barium carbonate, talc, Fuller's earth, types of infusorial earth and types of clay.

Coefficient of friction of any given lubricant is a factor of small importance when considered from the standpoint of deep-drawn heavy metal stampings of small surface area. However, when considered from the standpoint of stampings drawn from light-gage sheet of great area, it becomes a factor of serious importance.

If the coefficient of friction is too low, the metal slips too freely into the die cavity, resulting in an unevenly drawn or wrinkled work-piece. If the coefficient of friction is high, breakage of the sheet takes place at the point of greatest stress.

Excessive adhesiveness of a lubricant also has a marked tendency to cause the sheet to open its grain structure because of the overstressing of the metal while drawing. Sheet metal having high percentage of stretcher strains is often affected by the adhesiveness of the drawing lubricant in use. In the preparation of well-balanced lubricating mediums for sheet metal drawing purposes, it is necessary that the lubricant be accurately adjusted as to coefficient of friction.

Soluble Oils

Surface tension of good drawing lubricants should be low because lubricants, generally used for metal cutting and drawing purposes, are efficient or inefficient in direct proportion to their wetting properties. The wetting property of any given lubricant is of extreme importance, and this factor is reflected in surface tension.

Most cold-drawing lubricants are prepared in the form of water-soluble emulsions. There are several reasons why they are so prepared. The principal reason is the dependence upon the soap base of the lubricant. It is only by means of emulsification that the soapy materials can be uniformly dispersed throughout the unsaponified oily portion and maintained in that condition. Secondly, the suspension of the solid material is more readily accomplished and the compound is readily adjustable to various operations by water-dilution.

Solubility in alkaline solutions is desirable in the interests of subsequent cleaning operations. Stability against separation is an absolutely necessary requirement.

Drawing lubricants are sometimes compounded of materials that are toxic in effect upon workmen. This results in poisoning by absorption, and such con-

ditions must be carefully avoided. Lead carbonate is particularly harmful in this direction.

Color and odor of drawing lubricants, must be not unpleasant. Color is of serious import when the lubricant is used on such stampings as automobile fenders and body panels. When such stampings are drawn, uniform lubrication does not take place on all sections of the draw ring. The lubricant is only applied to those locations on the draw ring where the metal is expected to flow freely into the die-cavity. At other locations on the draw ring, the metal is expected to hold with little or no movement. No lubricant is applied at those points. Definite color of the lubricant aids the operator in applying only where required.

Base Constituents

Two of the most importnat oily substances which form satisfactory bases for drawing lubricants are, in order of importance, beef tallow and castor oil. Of these tallow, with an approximate film strength of 40,000 lbs., and a coefficient of friction of 0.005, is generally satisfactory in performance when used in its natural state as a drawing lubricant. Its film strength is considerably lower than that of castor oil, which is approximately 60,000 lbs., and its coefficient of friction is ten times lower than that of castor oil, but its wetting power appears to be much higher.

Therefore, if, as stated, the above two substances are effective mediums from which to compound a good lubricant, it is desirable to take advantage of the higher film strength of the castor oil and the higher wetting properties and lower coefficient of friction of the tallow. The simple compounding of these two substances together does not result in a medium possessing proper physical conditions for economic and efficient use as a drawing medium.

However, by chemical treatment of these substances (by saponification, sulphonation and emulsification), we are enabled to take advantage of the peculiar characteristics of each. When they are so blended or compounded in correct balance, they produce truly remarkable lubricating results.

In the cold-working operations of all metals, where such operations require lubrication, whether it be the cleavage of metal or shaping of it by plastic working, peculiar influences of lubricants are noted. It is a fact well understood by engineers and chemists that all metals, with the exception of aluminum, tool more readily and effectively under influence of lubricants derived from fatty sources.

It can hardly be stated that these influences are caused by chemical action. They are more likely caused by physical action or condition, but insofar as we can describe them, they result principally from the wetting principle and film strength of the lubricant.

In late years, we have noted the intensely efficient effect of sulphurized lubricating mediums. By sulphurization of mineral lubricants we are enabled to match, and in some instances surpass, the performance of lubricants derived from fatty sources. Sulphurized mineral oils are particularly effective lubricants on punching and shearing operations, and on short draws, and on heavy metal where the work-piece must be kept free from scores.

We cannot observe that the sulphurization of an oily medium increases its wetting power. We know that the thermal properties of the lubricant are affected by sulphurization, but this hardly explains their efficient performance. We are beginning to believe that perhaps there is chemical influence in some manner exerted, but nobody to our knowledge has offered a satisfactory explanation in this direction.

It has recently come to light that lubricating mediums, treated with chlorine or with chlorine-bearing compounds, are greatly enhanced in their lubricating performance. It is peculiar to note that the introduction of such a volatile substance as carbon tetrachloride to an oily medium so fortifies its film strength as to make it well nigh indestructible when introduced into a machine bearing. This same influence is noted in a lesser degree when applied to lubricants for metal-drawing operations. The peculiar effect of such chemical treatment of lubricants has set afoot interesting research, and we are noting with increased curiosity the effect of other corrosive substances when introduced into compounded oil mediums.

In recent months, we have been amazed at the performance of certain organic sulphates in compounded lubricants. We have recently witnessed the almost impossibility of the scoring of a sheet-metal work-piece, drawn under the influence of lubricants bearing minor quantities of these sulphates. Their use thus far, however, seems impractical owing to their corrosive nature. They may, however, prove extremely effective on the newer stainless metals. We have as yet no data.

It is difficult to offer satisfactory explanation of either a physical or chemical nature of these curious results. It seems evident, however, from recent research, that an entirely new theory in principle of lubrication will ultimately result—a theory which will attach considerably more importance to the chemistry of lubricants and less importance to the purely physical properties.

Early Experiments With Color in the Shop

JOHN R. GODFREY

Color, either in a machine product or in plant equipment, is not as new as some of the younger generation seem to think. Fire apparatus and farm machinery have been brightly colored and have had fanciful decorations for many years. And lithographs of locomotives of the early builders show not only striking color combinations but artistic painting on the sides of the tender and cab.

At least forty years ago, a well known locomotive shop in western Pennsylvania painted all its machine tools white and thereby added greatly to the available light in a city that was then noted for its smoke. The management was highly pleased with the result, both in appearance and in its effect on the quantity and quality of the work. But the shop passed into other hands, and white gave way to conventional colors.

A few years later a manufacturer of electric motors in southern Ohio painted all his equipment with aluminum, believing it to be better than white as to lasting qualities and cost of maintenance. This plant incidentally was also the first to the writer's knowledge to be 100 per cent individually motor driven. White was also used on all the equipment in one of the well known press rooms of the country many years ago.

These early experiments were almost entirely with the view of increasing the light available around the machine. The effect of color either on the eyesight as a means of securing contrasts that would be easy on the eye and aid in seeing defects in product was not considered at that time. Recent developments include a variety of colors, even for machine tools. Black, gray, green, red and orange are used in various places with an occasional return to aluminum, although for the most part this is confined to buildings, cranes and similar equipment.

The question of cost in maintaining paint of any color, considering both chipping off by accidental blows and staining from either oil or cutting lubricant, must also be considered in all cases. Whatever the direct effect on production, pleasing colors either singly or in combination undoubtedly have a good effect on the shop personnel and have a dollar and cents value.

What the Designer Expects from the Shop

Reduction in shop variations and the use of flexible equipment constitute two ways in which those responsible for production may cooperate with the engineer

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THAT the production specialist's day is over, as has been said, is certainly not true. We believe that the need for production ingenuity is greater today than ever before. Engineering standards have gone up, perhaps because business is down.

The engineer looks to the shop for major assistance in the realization of his improved ideals. He expects from the shop progress along two distinct lines:

1. Voluntary reduction in variations.
2. Increased mobility for change.

By the first is meant a reduction in variation from the mean specifications, such as usually is represented by tolerances, specified and otherwise.

A group of trouble-makers can be found in structural variations. These can best be illustrated by considering a crankcase and a cylinder block. The walls of these units vary in thickness approximately ¾ in. If this allowance is included in the specifications as a tolerance, it usually is all plus, which means weight, and somebody must pay for the iron. If this variation is not allowed for in the specifications, we must deal with a possible weakness. This weakness may produce resonance and roughness, and this is not in keeping with current engineering requirements.

A structure like a crankcase is certain to incorporate critical locations which are supersensitive to metal variations. A good crankcase is carefully developed, or we might say calibrated as is a carbureter, to obtain the maximum structural effect for the minimum weight.

To go through a crankcase with a fine-tooth comb is useless unless some assurance can be had from the shop that the dimensions can be held. When we bear in mind the fact that it is possible to effect a structural gain of 40 per cent in a crankcase by an addition of 3 per cent in weight, the importance of variation can readily be seen.

These variations include those of the foundry and the machine-shop. The machine-shop can help by accurate location points and the rapid check-up of castings as they are received. This will avoid the piling up of unsatisfactory stock, usually absorbed in production.

The characteristics of a powerplant are largely controlled by the accuracy of the centers, roundness and straightness of cylinder and crankshaft and camshaft bores. More attention must be given to the variations at these places.

Another important variation, giving considerable field trouble, is that from true concentricity of valve-stem guide and bosses with the valve-seat throat. Eccentricity here results in poor valve life and generally an engine performance that is below par. Opportunity exists for development of tools for machining these parts. Improvement in accuracy would be as far-reaching in its satisfaction as eccentricity has been annoying in the field and to the engineer.

Machinists in the shop appreciate quiet tappets, and although concentric valve seats are not a cure-all for noise, the development of a good quieting ramp on the camshaft is impossible if the valves are "acting up" on their seats. Here is an opportunity for the machine tool maker to point the way with new tools or methods for more concentric valve seats. This means quieter, smoother engines and maximum power for a longer operating period. It presents an outstanding opportunity for more result per dollar.

Variations in the crankshaft are sources of concern to the engineer. The crankshaft is literally infested with tolerances to cover manufacturing variations and still more that are not listed. No doubt the specified variations are necessary today; but what improvement may we expect? Are you doing anything about straight journals on crankpins and main bearings? What about smoothness of finish, and what is being done to reduce the required tolerance on diameter? What is being done to narrow down variations here in crankpin index and radius?

This last point is today the outstanding element in heavy corrections for out-of-balance conditions. Sometimes we note heavy grinding on cheeks that is all out of proportion to forging variation. This takes time and may weaken the shaft structurally, and because of the time involved, tends to create a shop demand for wide tolerance for balance. With proper cooperation between engineer and forge plant, arrangements can be made whereby the crankshaft forging will be ideal for balancing. However, no forging compensation can be made for position error in crankpins. This presents another opportunity for the machine tool man to show what he can do.

Variation Causes Concern

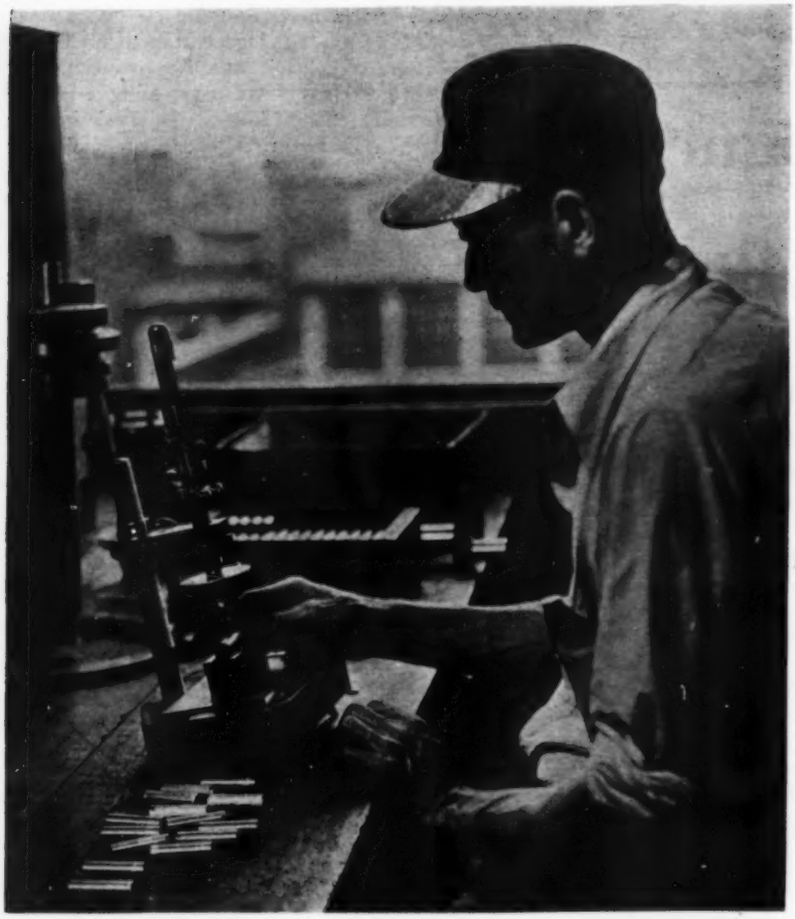
A better understanding of crankshaft balance is required. Today crankshafts are being held to ½ in.-oz. out of balance, which is good; but the important point is, where is the out of balance? The shaft, though checking to ½ in.-oz. out of balance, may actually be 24 times this much under operation if consideration is not given to the position of the out of balance and a couple is permitted to exist. Increased tolerance for out of balance is preferred to incorrect position.

The engineer and the forge shop can collaborate to the extent that all forgings shall be heavy in the desired plane. This would still mean nothing if crankpin position error is permitted. Very little position error of the pins can create considerable out-of-balance effect.

Reciprocating parts of an engine are respected by both the shop and the engineer, but like the crankshaft, they are smothered in tolerances, with resulting weight variations. Selective assembly is the present way out. However, what is being done to bring all rods and pistons to one weight? We need automatic weighing equipment that is easy to use and that will indicate how much must be taken from each piston to bring all to the same weight. This will leave us with only the fit variation for selection. Likewise, connecting rods should be designed and manufactured to a uniform weight, so that any rod will fit any engine in the field and shop. This means maintaining consideration of interchangeable fits.

We could go through every piece of

Abstracted from an S.A.E. paper presented at the Metal Congress in Buffalo, N. Y., October 3, 1932.



Engineering decisions are based upon tests of various kinds, and if manufacturing variations are not discounted, trouble may follow. If the variations are large, the effect of the investigation is lost

the car and raise questions as to what is being done to reduce tolerances. For instance, spline shafts are an endless source of trouble because of the tolerances required under present methods of fabrication. What shall be done about it? To ask is easy, but to execute no doubt is difficult.

To change with the trend is second in importance only to creating the trend. to do either, we must be able to make changes without the tremendous expense of the immediate past. The greatest obstacle to mobility to change is expensive tools. I do not mean by this that high-grade machine tools cannot be used; there can be no return to the file and solder iron. I mean that both large and small tools must be designed with facility for change.

One of the worst examples of immobile tools is cylinder-boring equipment provided with fixed heads. In the last few years, as you know, the reamer has been applied to the engine of our industry, and in most cases, the larger bore was obtained without any change in bore centers. Reduction in water-passage area was the result, with its many evils for foundry and field. Uneven cooling of bores, which follows such restrictions, will give trouble through the life of the car. It breeds blow-by and hot oil; compression leaks and power loss, worn piston-rings and excessive oil consumption. Such an engine may be bigger, but it certainly is not better. However, the centers have been saved. Fixed-center machinery is to blame.

We must have rugged accuracy without fixed centers. This principle applies throughout. Progress may demand the shifting of one hole in a group. Fixed-center machinery may make the change prohibitive or at least costly, hence a product that is unsatisfactory at some point is continued through production because of the cost of changing. This does not mean that we must go back to the single-spindle machine; it calls for equipment with adjustable centers without sacrifice of accuracy.

Location holes for positioning the product in the jigs are necessary, but suppose that these dowel holes are in such a location that a needed change would require that they be moved a little. Today, in some shops, that would be a catastrophe; it would affect every jig in the cylinder-block line. Why should this be so? Location dowels should be incorporated in fixtures in such a way that they could be moved or firmly fixed at will to suit the job in the shop.

The mental attitude of the men in the shop to change in machining methods to facilitate changes in the product is worthy of mention. Suppose it becomes necessary to increase the rigidity of a crankshaft, which may require cheeking. Considerable protest arises in a shop that is not cheeking the crankshaft, which is a difficult and unsatisfactory operation. Why? Probably because suitable tools are not available or the sequence of operations would be disturbed. The shop is entitled to its "rathers," but shop habits also must undergo development in mobility to change.

Good engineering ideas or principles often are doomed because the designs cannot be made economically if at all. But this is the day of new ideas; if competition is the life of trade, new ideas are the life blood of competition.

The suggestion has been made that the engineer call in the machine tool specialist to collaborate on designs while they are still liquid. This might lead to the successful production of an item heretofore regarded as beyond redemption.

What would our associates in the production department do if the engineer told them how to do their job or where they should buy machine tools? Yet new ideas must be given consideration even when apparently impractical from the producing standpoint. The outside specialist, with his incentive for new-tool sales, should be brought into consultation, but by the shop. Rather than discard a new item, the shop should pass the problem of its fabrication out among the various tool companies in which it has confidence. Thus, casting the bread of our ideas upon the waters of machine tool genius may result in a return other than just wet bread.

New Investments

We ask for a voluntary decrease in variations and improved mobility to change. These must not be conflicting requirements. One without the other would be insufficient. Appreciation of each of these elements exists today. However, they need more consideration, particularly when appropriations for new or changed products are in the offing. If new investments are in order, let us give consideration to these principles. Who knows but that the promotion of these very principles may help the appropriation along.

Contour Calculations for Forming Tools—VI

O. A. JOHNSON
Chief Tool Designer
Tyson Roller Bearing Corporation

Continuing his analysis of the tool set-up described in Article V of this series, the author gives the method of design for a circular finishing tool set and fed at an acute angle

NOTHING in forming tool design has met with more skepticism than circular forming tools set at angle and also fed at an angle less than 90 deg. to the center line of the product. The writer has proved, however, that this type of forming tool is practical, economical and fool-proof. Because of the many instances in which a larger portion of the profile can be made with one tool, tool costs, set-up time and tool sharpening are reduced.

In the last installment, we calculated a circular forming tool set at an acute angle but fed at 90 deg. to the center line of the product for rough forming the cone of a tapered roller bearing. Now we will calculate a circular forming tool for finishing the same part. Fig. 42 is the plan view of the product with the tool in finished position; Fig. 43 is the end view of the tool in finished position; Fig. 44 is the end view of the product with the tool in finished position; and Fig. 45 is a layout of the tool profile.

Many believe that a forming tool can be designed only to do the roughest work and that the more delicate undercuts and grooves should be formed with separate tools. Experience has proved, however, that all undercuts and grooves, as far as possible, should be formed with the finishing forming tool. A sharp corner or a nib on the finishing forming tool will last practically as long as the rest of the profile, provided the tool has been designed with the proper periphery clearance and rake angle. The reason for this is that the heat generated at the cutting edge is carried away from the nibs and the sharp corners on the tool and is absorbed by the body of the tool. The location of the grooves and undercuts on the product and also the depth of these may be important, and therefore, it should be all the more necessary to have as many of these as possible incorporated in one tool.

First of all, the important points on the product should be numbered. As the space is limited, we will leave out the calculation of Point 9, as this is just a repetition of Point 7 with different figures.

It will readily be seen that the surface from Point 7 to Point 9 (Fig. 42) and also the undercut of this surface are the critical cutting edges as far as periphery clearance is concerned. The angle that these two surfaces on the product form with the vertical line will determine at what angle the tool should set and feed.

These different factors determine the periphery clearance angle at the cutting edges from *P9* to *P7:*

1. The setting angle *B1* of the tool.
2. The setting height *B14* of the tool above the centerline of the work.
3. The diameter of the tool, $2 \times B11$.

The diameter of the tool will, of course, depend largely on the diameters of the product at *P7* and *P9*. The periphery clearance angle of the tool at the undercut *P1* to *P9* should not be less than 4 deg., that is, the angle that the cutting edge forms with the smaller internal conical surface of the product. This angle can be exactly calculated, but this calculation is rather complicated and should be dealt with separately. Because of the angular position of the tool, it is safe to make angle *B6* not less than 12 deg. and not more than 15 deg. for any kind of steel, as the true periphery clearance in this case would not be less than 4 deg. to 8 deg. at any point of the tool, provided angle *B119* is large enough. The rake angle of course should be variable for the different kinds of steel. The distorted rake angle *B17* is the angle that we have to consider. This angle is found by dividing the tangent of the rake angle *B5*, by the cosine of angle *B2*. If we make *B1* 45 deg. and *B5* 15 deg., angle *B17* will be about 20 deg., which is all right for steel under ordinary circumstances.

The difference between the diameter of the tool at Point 1 and Point 2 is considerably great, and therefore, the rake angle of the tool must be ground at an angle with the center line in order to bring Point 2 up to the center line of the product. The base line A-A should be drawn, and where lines drawn from the respective points perpendicularly to the center line of the product intersect this base line, we will obtain new imaginary points, which will all be located on the center line of the product because Point 2 has been calculated to fall on the center line.

The following gives the method for calculating tool dimensions:

B1 = feed angle
90 deg. — *B1* = *B2*
B2 — *A1* = *B3*
A49 × cos *B3* = *B4*
B5 = rake angle
B6 = periphery angle
B5 + *B6* = *B7*
A49 × sin *B3* = *B8*
B8 × sin *B5* = *B9*

$$\frac{B9}{B4} = \tan B10$$

B10 = vise angle
B11 = radius of tool at *P1*
B11 × cos *B6* = *B12*
B12 — *B8* = *B13*
B11 × sin *B6* = *B14*
B14 = setting height

$$\frac{B14}{B13} = \tan B15$$

$$\frac{B13}{\cos B15} = B16$$

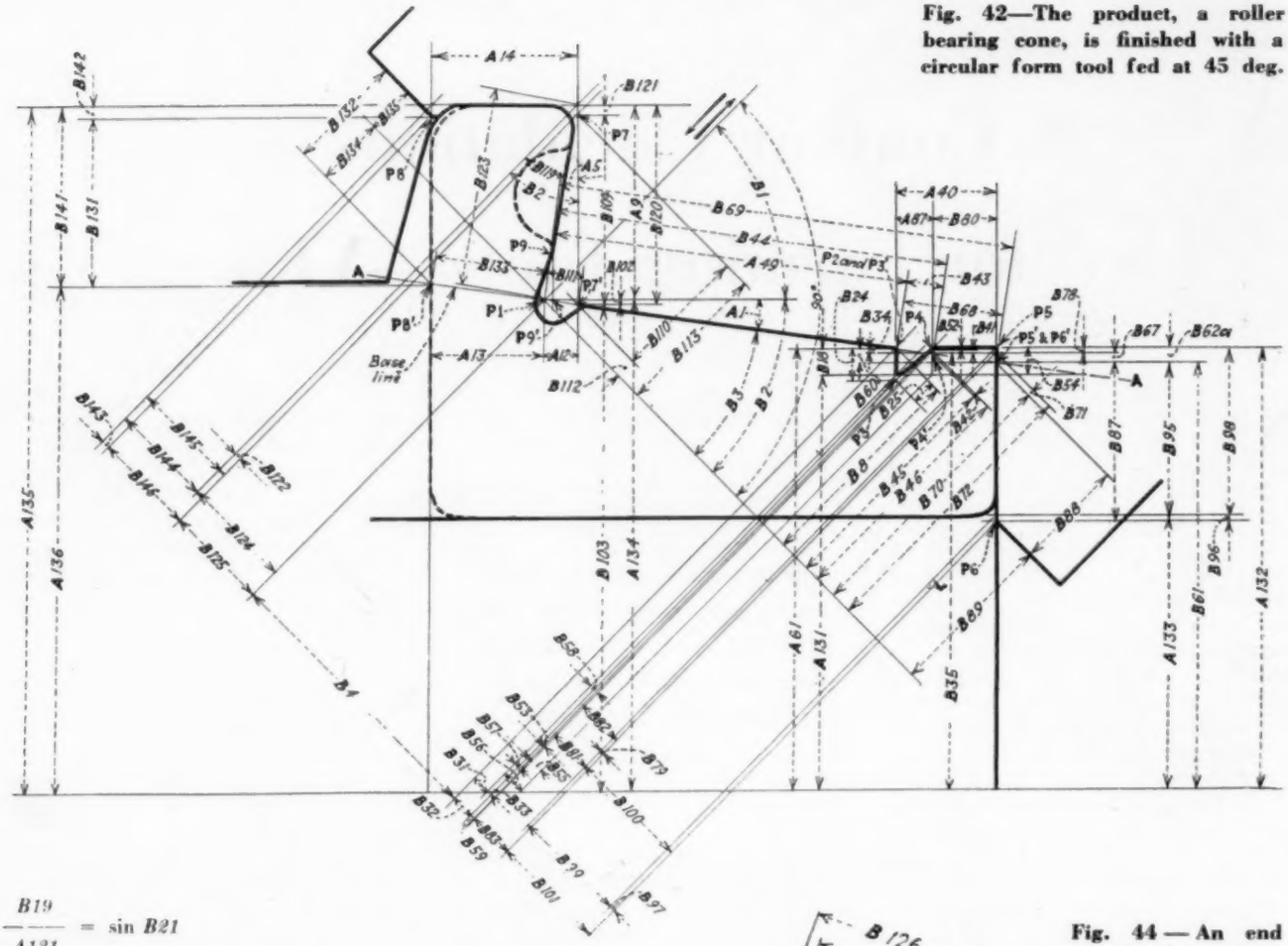
B16 = radius of tool at *P2*

$$\frac{\tan B5}{\cos B2} = \tan B17$$

B17 = distorted rake angle
A61 — *A131* = *B18*
A61 × sin *B17* = *B19*

$$\frac{B19}{\tan B17} = B20$$

Fig. 42—The product, a roller bearing cone, is finished with a circular form tool fed at 45 deg.



$$\frac{B19}{A131} = \sin B21$$

$A131 \times \cos B21 = B22$
$B20 - B22 = B23$
$B23 \times \cos B17 = B24$
$B24 \times \cos B2 = B25$
$B25 + B13 = B26$
$B24 \times \tan B17 = B27$
$B14 - B27 = B28$

$$\frac{B28}{B26} = \tan B29$$

$$\frac{B26}{\cos B29} = B30$$

$B30$ = radius of tool at $P3$
$B18 \times \sin B2 = B31$
$B24 \times \sin B2 = B32$
$B32 - B31 = B33$
$A87 \times \tan A1 = B34$
$A61 - B34 = B35$
$B35 \times \sin B17 = B36$

$$\frac{B36}{\tan B17} = B37$$

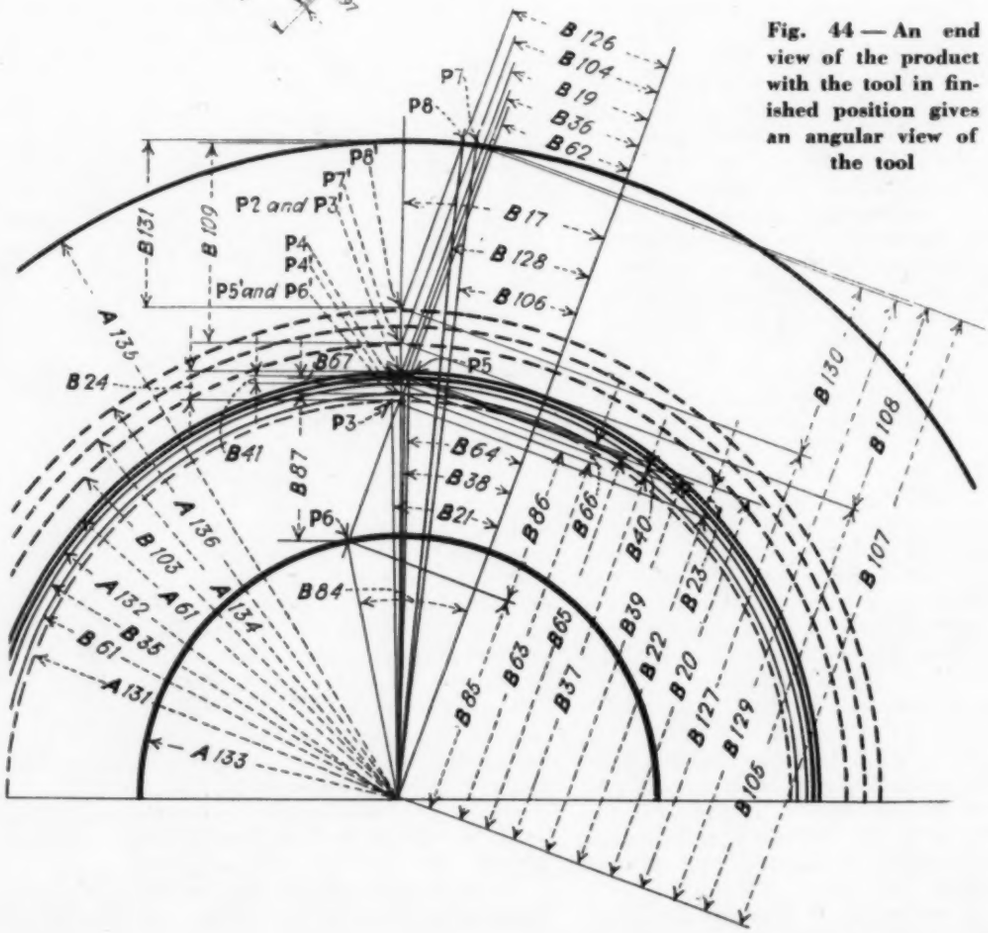
$$\frac{B36}{A132} = \sin B38$$

$A132 \times \cos B38 = B39$
$B39 - B37 = B40$
$B40 \times \cos B17 = B41$
$B41 \times \cos B2 = B42$

$$\frac{A87}{\cos A1} = B43$$

$B43 + A49 = B44$
$B44 \times \sin B3 = B45$
$B45 + B42 = B46$
$B12 - B46 = B47$
$B41 \times \tan B17 = B48$

Fig. 44 — An end view of the product with the tool in finished position gives an angular view of the tool



$B48 + B14 = B49$

$$\frac{B49}{B47} = \tan B50$$

$$\frac{B47}{\cos B50} = B51$$

$B51$ = radius of tool at $P4$
$B34 - B41 = B52$
$B52 \times \sin B2 = B53$
$A132 - A131 = B54$
$B54 \times \sin B2 = B55$
$A87 \times \cos B2 = B56$
$B56 - B55 = B57$
$B57 + B53 = B58$
$B58 - B33 = B59$
$A40 \times \tan A1 = B60$
$A61 - B60 = B61$
$A132 - B61 = B62a$
$B61 \times \sin B17 = B62$

$$\frac{B62}{\tan B17} = B63$$

$$\frac{B62}{A132} = \sin B64$$

$A132 \times \cos B64 = B65$
$B65 - B63 = B66$
$B66 \times \cos B17 = B67$

$$\frac{A40}{\cos A1} = B68$$

$B68 + A49 = B69$
$B69 \times \sin B3 = B70$
$B67 \times \cos B2 = B71$
$B71 + B70 = B72$
$B12 - B72 = B73$
$B67 \times \tan B17 = B74$
$B74 + B14 = B75$

$$\frac{B75}{B73} = \tan B76$$

$$\frac{B73}{\cos B76} = B77$$

$B77$ = radius of tool at $P5$
$B62a - B67 = B78$
$B78 \times \sin B2 = B79$
$A40 - A87 = B80$
$B80 \times \cos B2 = B81$
$B81 + B79 = B82$
$B82 - B53 = B83$

$$\frac{B62}{A133} = \sin B84$$

$A133 \times \cos B84 = B85$
$B63 - B85 = B86$
$B86 \times \cos B17 = B87$
$B87 \times \cos B2 = B88$
$B70 - B88 = B89$
$B12 - B89 = B90$
$B87 \times \tan B17 = B91$
$B14 - B91 = B92$

$$\frac{B92}{B90} = \tan B93$$

$$\frac{B90}{\cos B92} = B94$$

$B94$ = radius of tool at $P6$
$B61 - A133 = B95$
$B87 - B95 = B96$
$B96 \times \sin B2 = B97$
$A132 - A133 = B98$
$B98 \times \sin B2 = B99$
$B99 + B97 = B100$
$B100 - B79 = B101$
$A12 \times \tan A1 = B102$
$A134 - B102 = B103$
$B103 \times \sin B17 = B104$

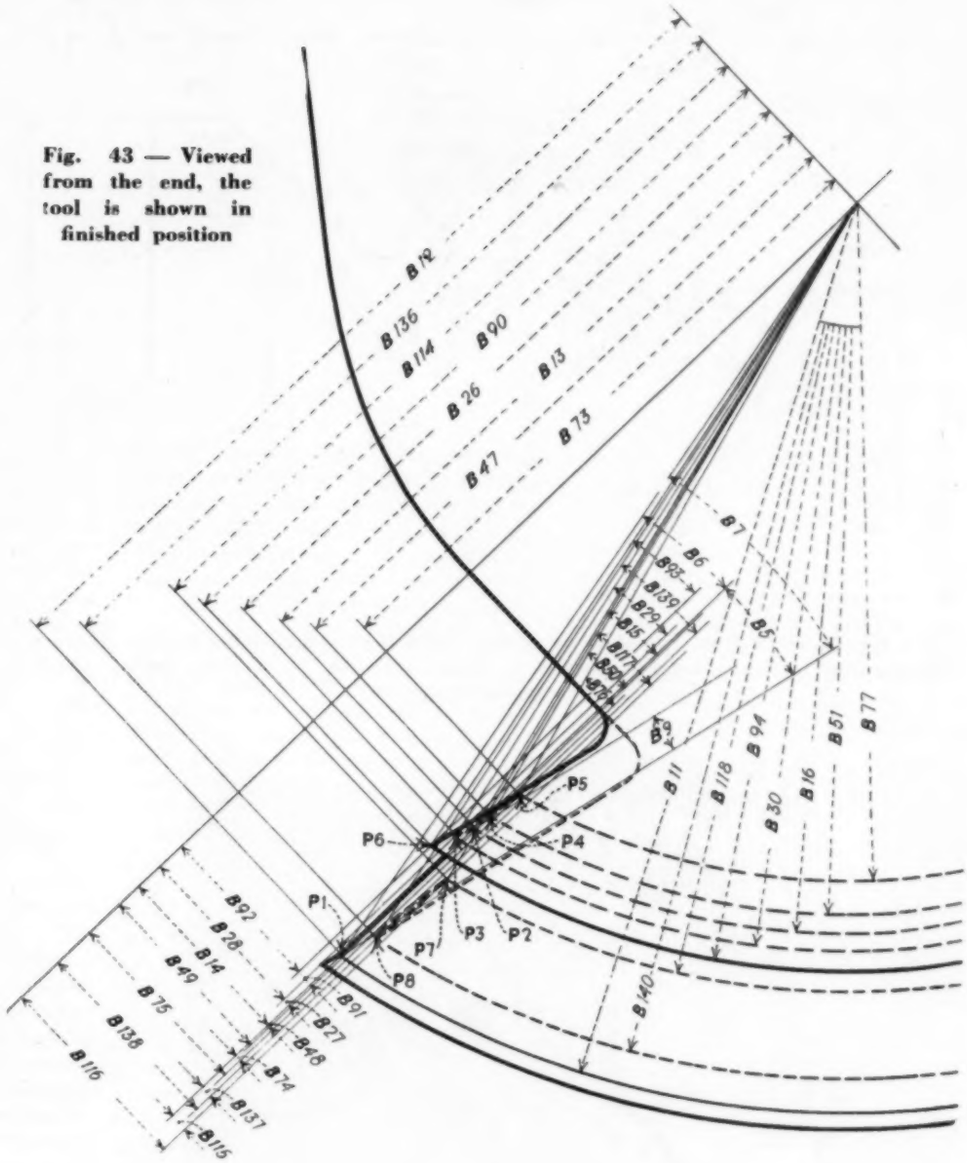


Fig. 43 — Viewed from the end, the tool is shown in finished position

$$\frac{B104}{\tan B17} = B105$$

$$\frac{B104}{A135} = \sin B106$$

$A135 \times \cos B106 = B107$
$B107 - B105 = B108$
$B108 \times \cos B17 = B109$
$B109 \times \cos B2 = B110$

$$\frac{A12}{\cos A1} = B111$$

$B111 \times \sin B3 = B112$
$B112 + B110 = B113$
$B12 - B113 = B114$
$B109 \times \tan B17 = B115$
$B115 + B14 = B116$

$$\frac{B116}{B114} = \tan B117$$

$$\frac{B114}{\cos B117} = B118$$

$B118$ = radius of tool at $P7$

$B2 - A5 = B119$
$A135 - B103 = B120$
$B120 - B109 = B121$
$B121 \times \sin B2 = B122$

$$\frac{A9}{\cos A5} = B123$$

$B123 \times \sin B119 = B124$
$B124 - B122 = B125$
$A136 \times \sin B17 = B126$

$$\frac{B126}{\tan B17} = B127$$

$$\frac{B126}{A135} = \sin B128$$

$A135 \times \cos B128 = B129$
$B129 - B127 = B130$
$B130 \times \cos B17 = B131$
$B131 \times \cos B2 = B132$

$$\frac{A13}{\cos A1} = B133$$

$B133 \times \sin B3 = B134$
$B132 - B134 = B135$

$B12 - B135 = B136$
$B131 \times \tan B17 = B137$
$B137 + B14 = B138$

$$\frac{B138}{B136} = \tan B139$$

$$\frac{B136}{\cos B139} = B140$$

$B140$ = radius of tool at $P8$
$A135 - A136 = B141$
$B141 - B131 = B142$
$B142 \times \sin B2 = B143$
$A14 \times \cos B2 = B144$
$B144 + B122 = B145$
$B145 - B143 = B146$
$B4 + B32 + B59 + B83 + B101 + B125 + B146 + 0.40625$ in. $= B172$
$B11 - B16 = B173$

$$\frac{B173}{B4} = \tan B174$$

$B30 - B16 = B175$

$$\frac{B32}{B175} = \tan B176$$

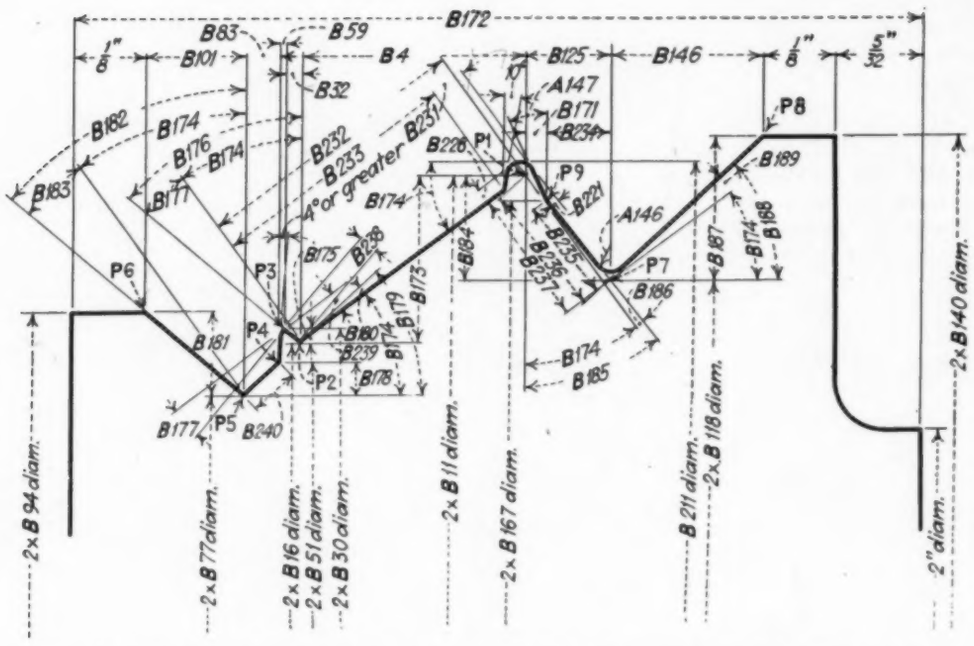
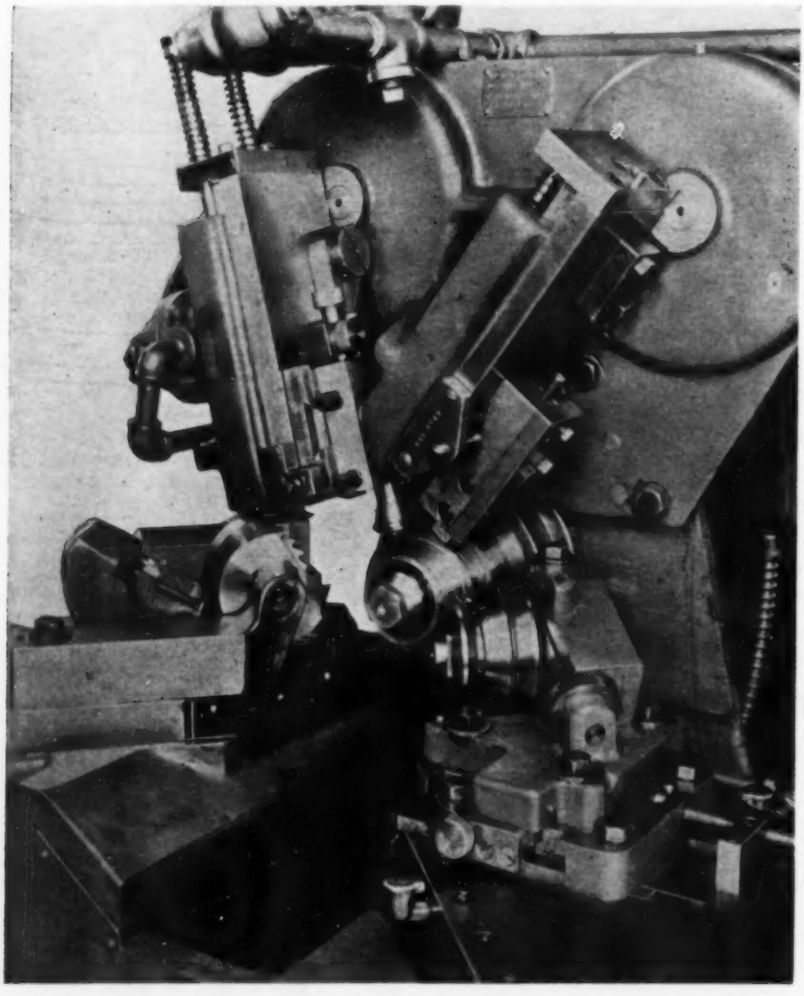


Fig. 45—Working from one plane to another from the accompanying layouts, the tool dimensions may be finally computed to compensate for the various factors which distort them

$$B176 - B174 = B177$$
$$B51 - B77 = B178$$
$$\frac{B178}{B83} = \tan B179$$
$$B179 - B174 = B180$$
$$B94 - B77 = B181$$
$$\frac{B101}{B181} = \tan B182$$
$$B182 - B174 = B183$$
$$B11 - B118 = B184$$
$$\frac{B125}{B184} = \tan B185$$
$$B185 - B174 = B186$$
$$B140 - B118 = B187$$
$$\frac{B187}{B146} = \tan B188$$
$$B188 - B174 = B189$$
$$\frac{B4}{\cos B174} = B232$$
$$B125 - B171 = B234$$
$$\frac{B234}{\sin B185} = B235$$
$$\frac{B125}{\sin B185} = B236$$
$$B236 \times \cos B186 = B237$$
$$\frac{B32}{\sin B176} = B238$$
$$B238 \times \cos B177 = B239$$
$$\frac{B83}{\cos B179} = B240$$

As explained previously, the actual computation of numerical tool dimensions is best accomplished by the use of logarithmic tables. An example is given in Article I of this series (*AM*—Vol. 76, page 896).



At the left is a circular roughing tool and at the right, a circular finishing tool; both are fed angularly on a Sundstrand lathe. The overarm carries a small internal forming tool fed in by a circular slide

Localized Copper Plating

JOHN E. HYLER

The article by D. L. Brown under the title given above (*AM*—Vol. 76, page 949) was very interesting as showing what can be done to prevent certain surfaces of parts from being plated. It is of interest to note the progress that has been made in late years in the matter of plating with various materials.

One thing that does not seem to be generally known is that there is on the market a special enamel which is an aid in localized plating. Any surface coated with this enamel is insulated and therefore can not be plated. Localized plating requires the use of a first-class insulating agent, and many concerns doing such work are finding the stop-off enamel well suited to their purpose. Being a non-conductor, the enamel can be used for the hooks and the racks.

Size Control in Grinding Operations

R. E. W. HARRISON
Secretary, Machine Shop Practice Division, A.S.M.E.

COUPLED with the problem of manufacturing accuracy is control of the finish of the piece as it leaves the grinding machine. It has been proved that according to the roughness or smoothness of the finish involved, so is the extent of the inevitable initial wear. Reference to Fig. 1 will clearly indicate that there is a quite appreciable margin of wear on even a smoothly ground surface, and it is necessary, if correct function is to be obtained over the maximum period of time, that this initial wear be taken into account when fixing the limits of accuracy to which the piece should be manufactured.

It is as true in an engineering sense as in any other, that it is the willing horse which is over-burdened. This has led to the over-burdening of the precision grinding machine by the indiscriminate loading up of stock removal, eccentricities, and other inaccuracies which it is assumed by those who do not know, that the grinding machine will remove most economically, and that the cost of production will still be low. No greater fallacy exists. The grinding machine is a metal removal tool, capable of removing metal at a certain maximum definite specified rate. There is a definite relationship between the horsepower of the machine and the rate of metal removal, and there is a definite relation between the speed at which accurate sizing can be accomplished and the accuracy of the work after the sizing operation.

In other words, in both internal and external operations, eccentricity must first be removed before sizing accuracy can be imparted. Also lack of parallelism, chatter marks, and other imperfections must first be removed.

In the case of the internal grinding machine with the grinding wheel carried on the end of a relatively small diameter spindle often greatly overhung, and necessarily operated in a condition and a place where the maximum rigidity is difficult to attain, the previous inaccuracies of the work prior to grinding exercise a tremendous influence over the amount of time taken to secure accuracy in size, concentricity, finish, parallelism, and freedom from periodic errors.

A nice balance must be maintained between the accuracies demanded from the operations preceding grinding and the grinding operation. Sometimes this is the cause of departmental disputes. However, this matter should never be permitted to become the subject of even departmental discussion. The work processing department should invariably set down the limits of accuracy for each operation, not only for the grinding, but for the turning, the boring, the milling, and in fact for the surfacing of any portion of the piece during the operations immediately preceding grinding. In many cases it is desirable, and in fact, economically necessary to specify limits of distortion to which the piece is permitted to go during heat-treatment, as it is quite conceivable that careless or ultra rapid heat-treatment, while being cheap in itself, can inject a production cost increase into the grinding operation out of all proportion to the saving effected by the speed of heat treatment or other operation. This one factor alone can jeopardize the efficiency of the whole manufacturing problem.

Automatic grinding machine operation entails a consistency in preceding conditions far in excess of that required for individual or manual production, and this condition has thrown a searchlight onto such factors as excessive stock, variation in stock, lack of parallelism, eccentricity, faulty centering, excessive burrs, lack of consistency in the metallurgical make-up of the material, and a host of other minor things, all of which exact their toll from the possible profit in the grinding operation. The practice of making inspections between operations is as good today as when it was first inaugurated.

There has been a phenomental growth in the application of surface grinding during the last fifteen years, and while this has entailed closer attention to details on the part of the foundry, the practice has been found economical and the results satisfactory.

The one factor which on occasion most adversely affects the economics of cheap surface grinding is the wide variation in the thickness of the pieces presented to the grinding wheel. Particularly is this true in the case of horizontal and vertical spindle surface grinding operations of the type carried out on the Diamond, Bridgeport and surface grinders, where work is bulky and much time is lost when it is necessary to short stroke the machine or to rotate the chuck while one piece only is being ground.

When building precision grinding machines, every machine must be made the subject of a rigid inspection test, both running light and under load, and the results recorded on a test sheet for future reference. It is obviously illogical to expect a machine produced to limits of accuracy of 0.0005 in. to produce work to an accuracy of two or three tenths of a thousandth, but strange as it may seem, such demands are sometimes made on

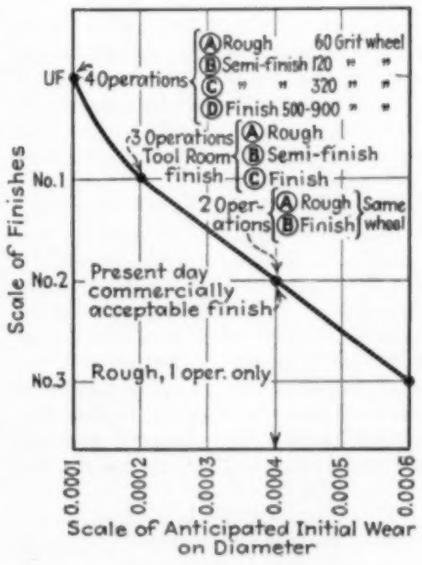


Fig. 1—The effect of smoothness on a ground surface is shown by this curve giving the relation between finish and potential wear

Abstracted from an A.S.M.E. paper presented at the Metal Congress, Buffalo, N. Y., October 3, 1932.

machine tools. Experience indicates that only supervision which is trained, and machinists, inspectors and erectors also, who have been trained to work in the finer brackets of accuracy, are capable of producing machines which will produce accurate work to start with and which will retain this accuracy over a period of years.

Resistance to Distortion

During recent years the increase in horsepower applied to grinding wheels has provided many new problems for the designer of the grinding machine, as stresses and strains are involved now which, even five years ago, were undreamed of. It is not unusual for motors of 60 h.p. to be applied to grinding wheel spindles, and even those motors are quite frequently overloaded. It will be realized by all those called on to deal with design problems involving such horsepowers, that a knowledge of the strength of materials and the possible effects of distortion is required. Here again, considerable thought and imagination are necessary to insure that, when distortion takes place and it is inevitable that such distortion will take place, its effects are minimized and rather than resulting in the spoiling of the work which is being operated upon, it will exert its influence in the other direction. In other words, rather than have the grinding wheel dig into the work and make it undersize, it is far better to have it spring away from the work and leave the work oversize.

With the increased use of the high production infeed type centerless grinding machine, wherein the cut is not permitted to die out, and the piece of work is submitted to grinding action for a prescribed period of time, it is absolutely necessary that distortion in the machine elements be kept down to a minimum and that, if and when it does take place, its effects will be to leave the work large rather than small.

With a grinding wheel weighing several hundred pounds and up to 36 in. in diameter, revolving with a peripheral speed of from 6,500 to 7,000 ft. per min., and with work rotating up to 120 ft. per min., the problem of natural frequency of vibration is a real one. Especially where, as is sometimes the case, these frequencies develop into harmonics and they in turn manifest themselves as chatter marks on the work.

The wise designer is always on the lookout for possible harmonic combinations and tries to so arrange his components that their frequencies are not likely to synchronize, the general tendency, of course, being to make everything heavy.

While this is commendable, it is not necessarily the answer to the question. Considerable judgment is required in regard to the proper distribution of metal in any modern precision grinding machine. The biggest bugbear which has still to be overcome in grinding machine operations is the provision of adequate dynamic balancing facilities for the high-speed rotating members. Ultimately it is to be expected that an automatic dynamic balancing of the grinding wheel spindle assembly will be possible, but until this mechanism is made available, it will always be necessary for the operator to watch the grinding wheel action, and whenever necessary, arrange the balance slugs in such a way that vibration caused by unbalance is kept at a minimum.

Backlash

Backlash and all its attendant evils are responsible for many of the difficulties in securing accurate size control. Modern designs recognize that backlash is inevitable, and therefore mechanisms are so arranged that backlash is kept in one direction, i.e., by the provision of spring pullbacks, balance weights, preloaded bearings, or pressure lubrication. Driving mechanisms are so arranged that with the backlash pulled in the reverse direction, i.e., with and added to the grinding load rather than substracted from it, it can exercise the least ill effect.

With the fine limits of accuracy to which component parts are now produced, the thickness of oil film at various temperatures has become a real problem and has led to some ingenious developments in the way of preloading, all designed with the idea of cutting out the effect of the variable film thickness of the lubricating oil.

The magnitude of the problem will be realized when it is known that the film between the spindle and bearings of many modern precision grinding machines is often in excess of the total tolerace on the work being produced. In other words, it is necessary for the spindle to float axially true in the middle of the oil film to insure that proper size control be maintained.

Temperature distribution in the machine becomes of increasing importance, as the limits or tolerances on the work become finer. Temperature change is a disconcerting variable which can cause endless trouble and its effects should be so directed and controlled that they exercise the minimum effect on the finished work.

It is because of this factor that we have to use a copious supply of coolant in all high production grinding operations, but it should be borne in mind that, while the coolant will transfer the heat from the work to the coolant, it passes from there into the body of the machine or the coolant tank, and must be so controlled from this point onward that its effects are not felt in the alignmen of the machine.

While it will be readily admitted by all designers and users that a certain amount of wear is unavoidable, there is a united opinion in favor of the arrangement of the wearing elements in such a way that change in size and shape will not affect the final accuracy producing qualities of the machine. For instance, it is frequently advisable to make spindle bearings of similar size when, according to the load carrying duties, one of the bearings could be made smaller. However, a nice balance of the merits of the case indicates that it is better to make both bearings the same size and secure greater uniformiy in wear which will automatically take care of alignment.

Nothing is quite so disconcerting to both the engineer and the production superintendent than to have to contend with the effects of aging in the machine components. This is a variable which increases in importance as the tolerance on the finished work diminishes. The almost unbelievable care which the manufacturers of plug gages, and particularly gage blocks of the Johannson or Hoke type go to, is ample evidence of the importance which must be attached to this particular problem in the securing of permanent accuracy.

Mechanical Principles

Such anomalies as over drives, disproportionate cantilevers, badly distributed loads, and negligence of the effect of lack of dynamic balance are all fundamental and an offense against any one of them is sufficient to jeopardize the performance of the whole machine. While it may seem strange that the fundamental principles of applied mechanics should be mentioned in an article of this kind, the explanation is that many years of experience and contact with a great variety of designers has indicated to the writer that practically all of the really serious errors which are made in machine tool design come under this heading.

An accurate sizing mechanism composed of such elements as cast iron, steel and lubricating oil is sensitive to outside influences, and for this reason the selection of the site for a precision grinding machine should be given just as careful consideration as the actual design of the machine itself.

The most commonly encountered outside influence adversely affecting the performance of the tool is vibration, and

for this reason care should be taken to locate the machine in such a way that vibrations from other machinery are not transmitted to it. Likewise, the location should be selected after due consideration to temperaure changes and freedom from dirt.

The dictates of high production requirements have tended during recent years to bring the dead stop mechanism method of sizing somewhat into disfavor, and the reason for this will be obvious if consideration is given to the following matters:

When traversing a unit of the machine, particularly a precision grinding machine up to a dead stop, the inference is that when securing the size, all spring in the slides and operating mechanism will be gradually dissipated until the cutting element eventually clears itself of the work. This is obviously a lengthy procedure, and while undoubtedly the dying out cut or, in other words, the sparking out of the grinding wheel method of sizing will continue to be used, it has ceased to be economically attractive where work must be produced in anything like mass production quantities.

Even with the increased use of hydraulic mechanisms, which lend themselves particularly well to dead stop limitation of movement, there is a growing tendency, growing because of its economic attractiveness, not to permit the grinding wheel to spark out, but by controlling the pressure of contact between the wheel and work to secure uniformity of size within the prescribed limits. The saving in time is enormous. Consider, for example, the problem of sizing the diameter of the stem on an automobile poppet valve. Handling this job on the center type grinder, where the cut must be allowed to spark out, production is something less than 1 valve per minute, whereas from 20 to 30 valves per minute can be produced on the centerless grinder with precisely the same dimensions and limits of accuracy on the work.

Automatic Sizing

No better example of lack of control over the sizing operation can be provided than in the operation of the older type of internal grinding machine not provided with automatic sizing facilities. With these machines, the operator frequently took more time to gage the work than he needed to actually grind it.

The three main types of automatic sizing mechanisms on the machines now on the market today all have their special merits, and it is significant that the latest to be released does not entail the use of a dead stop mechanism. In this case, the cut is finished in the air and by means of a light electrical contact alongside the grinding wheel, a circuit is closed which withdraws the wheel from the work.

The introduction of hydraulics has provided the machine tool manufacturer with a wonderfully sensitive means of controlling the approach to size zero, and the fullest advantage is being taken of this system where it is economically applicable.

It will be recollected that it was formerly necessary for the operator to check carefully the number of pieces he could grind before making compensation for the wheel wear, but even this procedure did not give him the necessary confidence to grind work without gaging every piece, and not infrequently this gaging time nearly equalled, and in some cases exceeded, the actual grinding portion of the work cycle.

Visible Warning

The main problem confronting the machine designer has been to produce a machine capable of sizing within close tolerances, the machine being operated by unskilled labor. This condition has led to the introduction of many ingenious gages, some with audible, but most with dial type mechanisms which automatically tell the operator when the high or low limit of the tolerance is being approached.

While gages of this type will, of course, check the work and tell the operator where his size errors are, this procedure only partially lightens the burden on the grinding machine operator in securing size, and it was not until the introduction of the grinding wheel wear compensating mechanism that any automatic means was made available to the trade at large.

The general acceptance of the theory that grinding wheels should be measured as regards efficiency by the amount of metal removed in a given time rather than by the length of time which the wheel would last, has automatically led to the use of much softer bonded grinding wheels than had hitherto been the case, and while this factor materially increased the rate of metal removal possibilities of most of the machines on the market, it also at the same time intensified the problem of grinding wheel wear compensation.

In those cases where the quantities of work involved are so small that it would not pay to set up a machine for entirely automatic operation, a compromise has been effected which amounts to a push button inching control over the sizing facilities on the machine. This type of equipment has many attractions, inasmuch as the operator when gaging the work, even at some point remote from the machine, can by pressing a push button, inch in the control one ten-thousandth of an inch at a time and therefore quickly bring the throat of the machine back to the necessary dimension to insure that the work is produced within the prescribed limits.

Inspection on the Machine

In all manufacturing schemes where close sizing within fine tolerances is a necessity, the cost of adequate inspection prior to assembly is an important one, this cost ranking in importance with the other cost elements in proportion to the limits of the tolerance and the efficiency of the means provided the inspector for checking these limits.

It will be readily appreciated, therefore, that in those instances where the functions of the inspector and the operator taking care of the final grinding operation can be merged, there are some real economies to be obtained, and it is this thought which actuates the provision of the automatic compensation for wheel wear equipment now found on many precision grinding operations.

Recognition of the fact that the dead stop method of sizing leaves a lot to be desired from both the points of view of accuracy and speed, a number of gaging devices have been developed, the chief of which are the Pratt, the Arnold and the Krupp. These devices are what might be termed indicating calipers, and as they are made in such a way that the calipering does not interfere with the actual grinding, the operator has in front of him a visible moving record of the size of the work, and as the amount of stock to be ground off diminishes, so the operator exercises a proportionate amount of caution as he approaches nominal size.

The use of this type of gage has effected some striking economies in the costs of production on almost every class of work to which it has been applied, particularly in the automotive industry where tolerances are fine and the limit system is worked to consistently.

Recent developments with the calipering type gage indicate that the day is not far distant when the caliper mechanism will actually control the movements of the cutting tool, and one such installation is already in use. In this particular case, as the finger on the dial gage approaches the tolerance limits, an electrical contact is made which causes the grinding wheel head to recede, the actual control coming from the gage itself. It is safe to say that developments along these lines will still further reduce the cost of production and particularly the cost of obtaining accurate size control under intensive manufacturing conditions.

Courtesy Worthington Pump & Machinery Corporation *Photo by Rittase*

Almost glasslike smoothness comes from final touch of honing stone

EDITORIALS

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Altruism Last

Despite all that has been said and written about the thoroughly practical, hard-boiled approach of the Robertson Committee to its appointed task of industrial rehabilitation, some people believe that the committee is embarking on another buy-now, ballyhoo, for-God's-sake-help-the-working-man drive. One look at the names of the men on the Robertson Committee and its sub-committees should be enough to show the foolishness of such an idea. Most of them are the heads of important businesses and they are not given to sentimentalism unless it pays.

This movement is an effort to revive industry, and more especially the heavy equipment section of it, through persuasion of those users of equipment who have the money, or can get it, to spend as much on replacement equipment as is warranted by the immediate savings that will result from the expenditure. If any such individual can find no place in his plant where it will pay to spend money for modernization, then he should certainly not feel any compulsion to do so. The Robertson Committee will not ask him to take any such action.

It is obvious that any money spent for replacement equipment will mean jobs for men in the equipment building industry. To that extent altruism is involved. But this whole campaign is based on the coldly calculating policy of self-interest first, altruism last.

Locomotive Repairs—the Largest Item of Railroad Expense

Locomotive repairs, according to a well-known authority, are the largest single item of railway expense. Data of 1929 show that repairs cost nearly twenty per cent more than fuel and electric power for all locomotives. Repairs almost equalled the total wages of all road and yard men.

The Baldwin Locomotive Works has made a study which shows how the cost of locomotive maintenance increases with the age of the motive power equipment. Roughly speaking, the cost doubles after the locomotive is three years old and continues to increase each year, though more slowly than at first.

A similar study of the machine tools of railroad shops would show even more striking examples of the savings to be made by keeping equipment up to date. A comparison of machining time on almost any locomotive repair work, will show that old machines lose money every day. Modern machine equipment will reduce maintenance costs and can play an important part in showing a profit in railroad operation.

Putting Metal Cutting Data to Work

Undaunted by previous failures and partial successes another A.S.M.E. committee to tackle the problem of putting metal cutting data in usable form has been organized. It meets this week to consider the program proposed by King Hathaway, its chairman.

Collectively, we know a lot about the cutting of metals. Individually, very few of us are in possession of more than a fraction of the total knowledge. Also, much of the information is not in such shape that it is readily usable in the seldom ideal conditions that surround everyday work in the machine shop.

Plenty of work awaits the committee. Aside from making existing information on the use of carbon and high speed steel tools available there is new ground to be broken. We still know little about the hard carbides, and there are rumors that new ones are on the way.

Other committees met obstacles that were too much for them. If this one is to succeed it must have, in addition to the enthusiasm and interest of its members, the hearty cooperation of the metal-working industry. Such cooperation is very much to the interest of every branch of that industry, particularly in these times.

Showing Up Obsolescence

Here is a suggestion that may help to start the management thinking about new machines even if it does not loosen up on orders immediately. Let each department head list every machine in his department that is ten or more years old. Put the date of purchase beside the machine. List the work it does, the cost per piece or lot and the expense of maintenance. In a parallel column put the machine that should replace it. List the time that would be saved by the new machine—not only per piece but per year, including maintenance charges.

Such a list will show the great progress made in machine equipment in ten years and the loss being sustained by the continued use of machines that are obsolete. It will indicate the most urgent replacement requirements and thus serve as a plan of action when appropriations become available.

It might also be well to list a few glaring examples of machines less than ten years old, that have been

made obsolete by more efficient designs. For obsolescence depends, of course, on the existence of better machines.

Parallels of this kind may not be deadly, but they can be very effective in prying loose orders for needed equipment.

Long-Life Cutting Tools

Tungsten-carbide and other special cutting tools meet extra sales resistance in times like these, because they have been considered mainly on account of their higher cutting speeds and consequently increased production. There is, however, another angle that should be carefully considered by shop executives to whom real economy is a vital subject. The life of tools, the time lost in changing and regrinding may be just as important as higher speeds. A set of tools that can stay in a machine during a day's or a week's run has much in its favor at any time.

• CHIPS •

All eyes on business activity barometers as time for seasonal peaks arrives . . . In the meantime carloadings have increased more than seasonally . . . Electrical energy production increased again for the last week in September . . . narrowed the gap between the figures for 1932 and 1931 . . . Steel production has increased . . . Gold continues to return from abroad and from domestic hoards . . . Stock market marks time . . . Politics and the Insull mess distract attention from other troubles . . . Federal Reserve Board index of factory employment shows advance.

Pennsylvania inaugurates suburban service near Philadelphia with first rubber-tired rail car . . . Central of N. J. gets $500,000 loan to rebuild locomotives, cars and marine equipment . . . 400 return to work at Laughlin sheet mill of Wheeling Steel Corp. . . . 750 back at Laughlin tinplate plant of U. S. Steel after 60 days out . . . G.E. increases oilburner production 50 per cent . . . Allis Chalmers receives $1,000,000 order for electrical equipment for N. Y. subway . . . Indianapolis Stove Co. increases to 5 days and expects to add to its force . . . Idle since last April, Elwood, Ind., plant of American Sheet and Tin Plate reopens with 1,200 men . . . 350 men recalled by Reynolds Spring Co., Jackson, Mich., during September, 800 more due to go back next week . . . Buick starts work on 10,000 cars, announcement of new model anticipated in November . . . will work five nine-hour days per week . . . Directors of Seneca Iron and Steel Co. of Buffalo approve merger with Bethlehem . . . Babcock and Wilcox books order for two big boiler units for Potomac Electric, largest public utility boiler order this year.

British cabinet reconstructed . . . echo of Ottawa Conference . . . Lytton Commission presents statesmanlike report on Manchukuo situation . . . Japanese militarists howl but conservative thought in both Japan and China sees in it a possible basis for peace in the East . . . Most of the various South American revolutions slow down or stop.

General Motors put New York office on 5-day week without pay cut . . . 10,000 affected . . . subsidiary companies to decide for themselves whether to follow suit . . . Ford reduces rates to 50-cent minimum for unskilled, 75-cent for skilled workers . . . continues 8-hour day . . . slashes salaries ruthlessly . . . Hoover asks railroad presidents to withhold pay cut notices until Jan. 1. . . . they compromise on Nov. 9 . . . Receivership proceedings started against Nickel Plate . . . N. Y. Central recals 4,000 machinists, B. & O. 1,800 . . . Coolidge heads non-partisan railroad commission sponsored by insurance companies, universities and other large holders of railroad securities . . . will study railroad to protect investments.

Breakfast will cost more . . . prune growers have completed a pool in California . . . coffee industry has organized itself . . . Rayon mills trying to catch up with demand . . . cotton and woolen mills operating at good rate although business is somewhat less . . . Southern mills buying considerable new machinery . . . Repair parts in large demand . . . Mercury vapor power station at G.E. Schenectady plant will be in operation next spring . . . Company will use steam, sell power . . . Movement toward registration of engineers grows . . . State Boards of Engineering Examiners will work with new Council for Engineering Development . . . Electric Railway Presidents' Conference develops a resilient wheel for street cars . . . Private shipyards offer to finance construction of three additional destroyers.

Construction volume index of *Engineering News-Record* rises from 111 in August to 124 in September . . . Construction cost index comes up slightly to 159.16 . . . *Metal and Mineral Markets* index of nonferrous metal prices rose from 44.77 in July and 47.32 in August to 51.18 in September . . . Sales of lead above average, price up 25 points . . . copper stationary, zinc off, tin unsettled . . . *Iron Age* composite price for heavy melting scrap drops from $7.75 to $7.67 . . . finished steel composite rises 25 cents a ton to 1.977 cents a pound, high for 1932 . . . *Power* surveys power plant equipment market . . . reports hold-ups caused by lack of will to buy rather than lack of funds or credit.

Metal Congress Attracts Engineers and Executives

Considering the current business conditions, attendance at the National Metal Exposition held at the 174th Regiment Armory in Buffalo, Oct. 3 to 7, under the auspices of the American Society for Steel Treating, was good. Several exhibitors remarked that although visitors were less numerous those who stopped to talk were generally executives rather than men from the lower ranks. Exhibitors were fewer in number, too, but there were enough to fill the armory comfortably, and the quality of the exhibits was generally excellent. Many new machines, devices and metal applications were shown.

Participating for the first time at the Metal Congress were the American Drop Forging Institute and the Wire Association. Cups awarded to companies having the most interesting exhibits were a new feature of the National Metal exposition held concurrently with the Congress. Winners of these tokens were selected by a committee of five appointed by the mayor of Buffalo: first prize, Jones & Laughlin Steel Corp.; second prize, Air Reduction Sales Co.; and third prize, the Grasselli Chemical Co. The New Jersey Zinc Co., Superior Steel Corp., and the Carborundum Co. received honorable mention.

In the engineering sessions of the various societies cooperating in the Congress much the same situation prevailed. Attendance was small but those who came were qualified to take part in discussions, and did so. The A.S.M.E. session on Monday evening was outstanding in this regard. The opening paper at this meeting, by R. E. W. Harrison on size control in precision grinding, is abstracted at considerable length in this issue.

The paper by L. H. Morin, chief engineer of the Doehler Die Casting Co., reviewed materials used in die castings and gave figures on relative costs of machined and die-cast parts. The discussion brought out the information that brass die castings are being made under something like 20,000-lb. pressure. An interval of 1/150th of a second is required for the actual casting, the metal being shot in in a plastic rather than a liquid condition. Die casting engineers have recently begun to consider the possibility of die casting steel. One engineer intimated that pressures would probably be of the order of 300,000 lb., and will entail much experiment in die design.

J. V. Emmons, metallurgist of the Cleveland Twist Drill Co., discussed materials used in cutting tools, outlining the capacities and limitations of each. He observed that carbon steel is still the most generally used material for cutting tools.

Coleman Selected to Head A.S.S.T.

In conjunction with the Metal Congress at Buffalo, N. Y., October 3-7, the American Society for Steel Treating held its annual meeting and selected its slate of officers for the coming year. Nominated for president of the society was vice-president W. B. Coleman, president, W. B. Coleman & Company, consulting metallurgists. Others nominated were:

W. H. Phillips, vice-president, Molybdenum Corp. of America, for vice-president of the society

William H. Eisenman, renominated for secretary

R. S. Archer, director of research, A. O. Smith Corp., for a two-year term as director

H. G. Keshian, metallurgist, Chase Companies, for a two-year term as director

With the foregoing the following will serve on the 1933 A.S.S.T. board:

A. H. d'Arcambal, sales manager, Pratt & Whitney Co., 1932 president of the society

A. T. Clarage, president, Columbia Tool Steel Co., treasurer

H. D. McKinney, vice-president, Driver-Harris Co.

C. F. Pascoe, metallurgist, Canadian Steel Foundries

The Montreal chapter of the A.S.S.T. was presented the R. M. Bird bell and gavel by President d'Arcambal for making the most notable progress during the year. At the annual dinner, October 6, Francis M. Walter, director of the bureau of metallurgical research, Carnegie Institute of Technology, was awarded the Henry Marion Howe gold medal for the best technical paper published in the Transactions. Cyril Wells, M. Gesamer, and John F. Eckel, all of the same bureau, were co-authors of the paper which was entitled, "Alloys of Iron, Manganese and Carbon."

The Past President's medal went to J. M. Watson, metallurgical engineer, Hupp Motor Car Co.

• INDUSTRIAL REVIEW •

Although prospective purchasers of machinery are more ready to listen to machinery salesman than they have been for some months, orders, as one machinery dealer puts it, dry up when they hit the front office. From various industrial centers come reports that potential buyers, frightened enough anyway, are shivering at the prospect of a Democratic victory in November. Many feel that such an event would postpone recovery at least a year. October opened with an increase in inquiries but practically no orders.

Chicago believes that nothing much will happen this year although many projects have advanced to the point where little is needed to turn them into sales. Some of the railroads are showing more interest in metal-working machines than they have in two years. Engineering departments of the Detroit automobile companies are seasonally busy. In some cases the tool departments are active. The larger independent die shops are busy, some of them working two shifts.

For the first time in months things look a little better in Cincinnati. Slight improvements in orders for new and used machine tools are noted, and supply business shows more than slight betterment. A few men have been added to the payrolls of various shops, and the Wm. Powell Valve Co. has put on 60. In Philadelphia inquiries seem to be much better. Orders are non-existent. Boston feels better and looks hopefully to results from Robertson Committee efforts. Sales continue at a very low ebb.

Commodity prices are firmer in the Cleveland territory. Automobile parts makers are getting very little from their customers, but railroad equipment orders are somewhat better, and inquiries very much so. A few men have been put on here and there but no important plants have opened up. Pittsburgh reports a favorable attitude toward the Robertson Committee although some manufacturers are still wavering on the fence between caution and courage. New York finds no change in activity. Local political uncertainty combines with state and national political fights to divert attention from any new industrial programs. Milwaukee also reports no change.

Exchange Restrictions Hamper Trade

Foreign exchange restrictions resulting from governmental control in 31 countries have had a deadening effect on American export business according to a report prepared by the U. S. Chamber of Commerce. Exporters hesitate to ship merchandise to countries from which payment cannot be received within a normal period of time. In 1931 we did $754,203,000 worth of export trade, some 30 per cent of our total export business with countries now maintaining restrictions.

Elimination of these restrictions can come only with a restoration of more stable and prosperous business conditions. However, five courses of action are suggested:

1. Present circumstances affecting exchange control for individual countries before the World Economic Conference.
2. Bilateral discussion of exchange conditions.
3. Establish committees to arrange the balancing of imports and exports between U. S. and countries where exchange control appears likely to continue.
4. Government representatives abroad should vigorously protect American interests against discrimination in the exercise of exchange control.
5. Make future moratoria on external public debt contingent on the modification or removal of exchange controls.

McKibben Receives A.W.S. Medal

The Samuel Wylie Miller medal, awarded annually by the American Welding Society for the outstanding contribution to the advancement of welding, was presented to F. P. McKibben, consulting engineer of the General Electric Co. Mr. McKibben is president of the society and received the award in recognition of his work in the field of structural welding.

Clausen Medal Goes to Wagner

At the annual meeting of the American Association of Engineers, Washington, September 28, Herman A. Wagner, consulting engineer, was awarded the Clausen gold medal for distinguished work conducted to promote the economic welfare of the engineer. Mr. Wagner is the author of many surveys on unemployment insurance and a study of "The Deadline at 40."

H. C. Dickinson

S. A. E. Nominates Officers for 1933

Nominating committees of the Society of Automotive Engineers have announced the names of those chosen for administrative offices of the society for 1933. Nominees are as follows: president, H. C. Dickinson; vice-presidents, Clarence M. Young, representing aircraft engineering, A. V. D. Willgoos, representing aircraft-engine engineering, Harte Cooke, representing diesel-engine engineering; M. C. Horine, representing motor-truck and motorcoach engineering; J. M. Crawford, representing passenger-car engineering; Roy F. Anderson, representing passenger-car-body engineering; Fred W. Cederleaf, representing production engineering, and J. E. Winchester, representing transportation and maintenance engineering.

Dr. Dickinson has been chief of the heat and power division, Bureau of Standards, since 1922, and was formerly physicist in charge of power plants research at the Bureau. He was elected a member of the S.A.E. in 1918, and has been active on the research committee, fuels subcommittee, riding-qualities subcommittee, highways subcommittee, headlighting subcommittee, cooperative fuel-research steering committee, highways subcommittee and lubricants subcommittee. He was chairman of the research committee from 1926-1928, and a member of the research committee from 1922-1932.

Mr. Cedarleaf is works manager of Muncie Products Division, General Motors Corp. He was elected a member of the society in 1919, and was a member of the production activity committee in 1932. His connections in the industry have been as follows: chief die designer, Studebaker Corp.; chief engineer, Sparks-Withington Co.; factory manager, Metal Specialty Co.; superintendent, stamping division, A. C. Spark Plug Co.; assistant factory manager, art-metal division, Ternstedt Mfg. Co.

National Registration of Engineers Indorsed

At a meeting held in New York September 22-24, the National Council of State Boards of Engineering Examiners gave formal approval to a system of national registration for engineers put into effect experimentally earlier in the year. Headquarters for the National Bureau of Engineering Registration have been established at Columbia, S. C., under the direction of T. Keith Legaré, secretary of the council. Hugh A. Kelly, secretary of the New Jersey board, heads the committee to administer the work of the bureau in conjunction with an advisory commitee appointed by national engineering societies.

As pointed out by David B. Steinman, president of the council, the bureau was proposed as the start of a program for engineering, beginning with the student in the college and prescribing educational requirements. However, since a similar movement inaugurated by the A.S.M.E. has received the indorsement of four major engineering societies, Dr. Steinman recommended that the council join the movement.

Exports of Agricultural Implements Rise

August exports of farm equipment from the United States registered a gain of 34 per cent over July, and were the largest monthly shipments since March, according to the Commerce Department's Agricultural Implements Division. The total value of the August exports was $1,883,944 as compared with the July figure of $881,243.

Exports of tracklaying tractors were particularly encouraging, the total of $327,706 being the heaviest since February, 1931, and greater than the entire shipments of this class of equipment during the first six months of 1932. Shipments of wheel tractors also increased favorably over the July figures recording a gain of 65 per cent.

Platt, New Britain Machine Founder, Dies

Frederick G. Platt, retired president of the New Britain Machine Co., died October 9, aged 84. At the time of his death, Mr. Platt was a director of the Stanley Works and of Landers, Frary & Clark. About forty years ago he reorganized the Case Engine Co. into the New Britain Machine Co., and was its president until his retirement in 1921.

Half-Year Exports of Metal Products Show Downward Trend

According to a summary of export figures by the U. S. Chamber of Commerce, 24 principal items out of 95 were shipped abroad in larger quantities for the first half of the year than for the same period last year. Although the three outstanding features were the extraordinary purchases of American cotton, wheat and petroleum, some metal products also showed a gain.

Sewing machines for household use were exported in greater quantity and value. 90,191 machines represented an increase of 87 per cent over 1931 but 14 per cent under the 5-year average 1927-1931. Exports of automobiles were less than half as large as in the first half of 1931, itself a period of extremely low exports. The value of exports of automobiles, parts and accessories declined 52 per cent to $45,657,000. This included 26,203 passenger cars, 82 per cent below the 5-year average. Exports of motor trucks and buses totaled 12,333, 58 per cent below 1931 and 80 per cent less than the 5-year average.

Exports of electrical machinery and apparatus valued at $24,097,000 were less than 1931 and 52 per cent below the 5-year average. Radio tube exports increased 42 per cent in quantity, but generators declined 67 per cent, motors 56 per cent, electric household refrigerators 37 per cent, commercial refrigerators up to 1-ton capacity 15 per cent, transformers 33 per cent and batteries 15 per cent.

Far down the list are agricultural machinery and implements with a total value of only $5,409,000, 89 per cent below the 1931 6-months' figure, almost entirely because of the decline in exports to Soviet Russia. Exports of wheel tractors almost ceased, the decline being 96 per cent in quantity. Exports of tracklaying tractors decreased by 67 per cent.

Power-driven metal-working machinery exports also declined sharply to $5,665,000 or 71 per cent lower than last year. Previously this machinery group had shown a steady upward trend for a long period culminating in 1930. Other declines in the metal-working field were: tubular products, 52 per cent; plain galvanized and barbed wire, 24 per cent; adding, accounting and calculating machines, 51 per cent; air compressors, 56 per cent; cash registers, 46 per cent; power pumps, 53 per cent; excavators, 68 per cent; printing presses, 71 per cent; typesetting machines, 63 per cent; and typewriters, 30 per cent.

Gains were made in iron and steel scrap, 51 per cent, and safety-razor blades, 29 per cent.

The British Empire and the United States were each other's best customers for the first six months of 1932. The fifteen principal countries of the Empire purchased more than 40 per cent of this country's exports. During the same period, nearly 30 per cent of all imports into the United States came from the British Empire.

Great Britain and Canada alone accounted for about one third our exports. Great Britain purchased American products in the first half of the year to the amount of $148,022,000 which was 35 per cent below last year. Exports to Canada, totaling $132,694,000, were 43 per cent less than in 1931.

Exports to Poland and Greece increased, the former by 7 per cent and the latter by 121 per cent. Purchases by Germany, our fourth best market, amounted to $53,406,000, a decline of 29 per cent. Our third best customer, Japan, showed the smallest loss, her purchases of $76,659,000 being only 2 per cent smaller than last year. Exports to France, fifth leading buyer, amounting to $54,803,000, declined 25 per cent.

Conference Board Reports On 5-day Week

Announcing the completion of its study in regard to shorter working periods, the National Industrial Conference Board recently made public some of its findings. A large majority of industrial concerns have already adopted some form of spreading work either by part time operation or by staggering work periods.

The report points out that while there is a general sentiment favoring some plan of spreading work, there are two schools of thought on the subject. One would reduce working hours without reduction in earning power; the other opposes any plan that would increase costs and raise prices.

Under present conditions, shorter work schedules have been put into operation at unchanged hourly rates of pay without general protest. However, under normal business conditions, the wisdom of such a policy is questioned because of the curtailment of earnings.

It has been estimated that about one half the annual expenditures in the United States come from wage earners whose average annual earnings are $2,000 or less. To the extent that this purchasing power is diminished a desirable market would be lost.

Drop Forging Survey by Commerce Department

Despite a decided fall in production since 1929, capacity in the drop forging industry has increased according to "Production and Capacity in The Drop Forging Industry," a study made public by the American Drop Forging Institute and the Department of Commerce.

While those concerns whose trend of sales has been downward have maintained their capacity, there are others whose sales have increased. The gain has been chiefly in production machinery with less substantial additions to land and buildings. In general, the trend in drop forging production closely follows the curve of automotive output, which industry at present supplies the principal market for drop forgings.

•BUSINESS ITEMS•

Entire stock of new and used machinery of Sun Machinery Co., Inc., 35-37 Van Buren St., Newark, N. J., will be sold at auction on Tuesday, Oct. 25, starting at 11:00 A. M. The sale will be conducted under the management of Samuel T. Freeman & Co.

Sidney Machine Tool Co., Sidney, Ohio, has granted exclusive agency in the New England territory for its line of Tritrol and Monotrol lathes to the Arthur Hastings Co., Inc., ParKett Machinery Division, Cambridge, Mass., which is being operated by ARTHUR KETTLE and FRANK PARKER.

The Belleau & Malo Co., East Providence, R. I., has been established at 1367 S. Broadway to manufacture copper-plate radiators for domestic heating purposes. JOSEPH BEALLEAU and FRANK MALO are the principals.

Underwood-Elliott Fisher Co., Hartford, Conn., has transferred the manufacture of its Underwood portable typewriter to the Hartford plant, operations being conducted previously at Bridgeport.

Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa., has announced that a manufacturing agreement has been concluded between it and the Torrington Mfg. Co., Torrington, Conn., whereby the physical test-

ing equipment designed by the former company will now be built at Torrington. However, the Riehle company will retain its corporate identity and will continue to conduct its own engineering and sales.

R. Y. Ferner Co., Investment Bldg., Washington, D. C., American representatives of Société Genevoise d'Instruments de Physique, Geneva, Switzerland, has announced sales appointments as follows: H. S. Huncke & Co., 27 S. Jefferson St., Chicago, Ill., as agents for measuring equipment and scientific apparatus, portable hardness testing instruments and Dialtometers, as well as invar and elinvar; Neff, Kohlbusch & Bissell, 2400 W. Madison St., will continue to handle the sales of Swiss jig borers, precision screw-cutting lathes and dividing machines in the Chicago territory; Triplex Machine Tool Co., New York, N. Y., Blackman-Hill Co., St. Louis, and Joseph C. Fletcher, San Francisco, will sell portable hardness testing instruments in addition to Société Genevoise machines; G. Robert Osgood, 128 Dexter St., Malden, Mass., will handle hardness testing instruments and Dilatometers. Other agents for portable hardness testing instruments are A. Preston Petre, 608 Stewart Bldg., Baltimore; Galvin Machinery Sales Co., Brisbane Bldg., Buffalo; Pacific Machinery & Tool Steel Co., Portland, Ore.; A. M. Andrews, 2215 Leslie Ave., Detroit, and La Chapelle, 389 St. Paul St., West, Montreal.

To round out its industrial marketing service, the G. M. Basford Co., 60 E. 42nd St., New York, N. Y., industrial marketing and advertising counselor, has instituted a new products department for the purpose of finding and developing new products for both industrial and general consumer markets. The company has appointed Nathaniel B. Wales, a well-known inventor, to be in charge of engineering and research.

The Sommer & Adams Co., 18511-17 Euclid Ave., Cleveland, Ohio, has announced appointment of Frank E. Artz, 2136 N. Newland Ave., Chicago, Ill., as representative in the Chicago district to handle the line of automatic polishing and buffing machines, continuous milling machines and continuous drilling machines.

Cadillac Machinery Co., 528 Fisher Bldg., Detroit, has been appointed exclusive agent in the Detroit territory for Watson-Stillman Co. and Kane & Roach, Inc.

Austin-Hastings Co., Inc., ParKett Machinery Division, Boston, Mass., has placed on its staff Ralph H. Anderson, formerly of Stedfast & Roulston, Inc., Boston.

The Jeffrey Mfg. Co., Columbus, Ohio, has announced removal of its Southwestern branch office from Houston to Dallas, Tex. T. P. Burke continues as manager.

Foote Bros. Gear & Machine Co., according to Abel Davis and Franklin H. Fowler, receivers, has announced appointment of representaives as follows: J. L. Kilroy, 114 Bauer Ave., Louisville, Ky., and C. H. Taylor, Johnston Bldg., Charlotte, N. C.

• OBITUARIES •

Edward Kneeland, 74, a founder of the Frank-Kneeland Machine Co., and afterwards an officer in the United Engineering & Foundry Co., Pittsburgh, died recently. The former company was merged with others in Pennsylvania and Ohio to form the present United Engineering & Foundry Co., of which Mr. Kneeland was elected treasurer in 1901, and of which he served as general manager until his retirement in 1923.

Enoch Ohnstrand, pioneer in the metal furniture and office equipment industry and consulting engineer of Remington-Rand Co., Tonawanda, N. Y., died recently following a brief illness. Mr. Ohnstrand served as general superintendent of the Art Metal Construction Co., Jamestown, N. Y., until 1910, when he founded the Ohnstrand Metal Furniture Co., Falconer, N. Y. In 1911 he went to Syracuse as general superintendent of the O. M. Edwards Co., and two years later became general superintendent of the U. S. Metal Products Co.

Charles G. Perkins, a manufacturer of electrical equipment and an inventor of such devices, died recently at the age of 83. Mr. Perkins organized and for many years was president of the Perkins Electric Switch Mfg. Co. of Hartford, which was sold to the Bryant Electric Co., of Bridgeport. He later organized and was president of the Perkins Corp., afterward the Arrow Electric Co., which was merged with the Hart & Hegeman Mfg. Co.

Aubrey D. Hiles, 78, formerly one of the executives of the Gurney Ball Bearing Co., Jamestown, N. Y., died recently. He retired when the company was taken over by the Marlin-Rockwell Corp.

Adolph Lomb, vice-president of the Bausch & Lomb Optical Co., Rochester, N. Y., died Sept. 30, aged 66. He had been connected with the company for 53 years.

Charles E. McSweeney, president of the American Steel Tank Co., Chicago, died recently.

Peter G. Minier, general superintendent of the Russell Car & Snow Plow Co., Ridgway, Pa., died recently.

• PERSONALS •

William L. Batt, president of S K F Industries, Inc., celebrated on October 3 his twenty-fifth anniversary with the company. Graduating from Purdue in 1907, Mr. Batt joined the Hess-Bright Mfg. Co. that year, and in 1917 became general manager. Upon a consolidation involving Hess-Bright and S K F Ball Bearing Co. to form S K F Industries, Inc., he became vice-president. In 1922 Mr. Batt was elected president. He is a member of the A.S.M.E. and the S.A.E., and has been active in the committee work of both societies.

George B. Ingersoll, assistant general manager of Fairbanks, Morse & Co., Beloit, and associated with the company for 31 years, retired October 1 at the age of 65 in accordance with the company's pension system.

R. C. Cosgrove, manager, refrigeration division, Westinghouse Electric & Mfg. Co., has been placed in charge of the company's domestic air-conditioning activities in addition to his present duties.

F. J. Rudd has been appointed managing engineer of the motor department of the General Electric Co., according to N. J. Darling, manager of the River Works at Lynn, Mass.

John D. Stevenson has been appointed sales manager of the State Machinery Co., Inc., New Haven, Conn., dealer in new and rebuilt machine tools and factory supplies. Louis W. Desenti is president.

• MEETINGS •

National Founders Association. Thirty-sixth annual meeting, Waldorf-Astoria Hotel, New York, November 16-17. J. M. Taylor, secretary, 29 South La Salle St., Chicago.

American Society of Mechanical Engineers. Annual meeting, New York, December 5-10. Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

National Exposition of Power and Mechanical Engineering. December 5-10. Grand Central Palace, New York.

THE ROUND TABLE

Books and Bosses

"What's the matter, Al?" questioned Ed as the two friends met for their occasional lunch together, "you haven't smiled since you came. Need any help?"

"Not the kind you can give us, Ed, but thanks just the same. We haven't any trouble—yet, but our bank balance is getting low, and I'm darned if I can figure out where the money went."

"That's a condition lots of manufacturers are suffering from, Al. That's the penalty of being a big business man in these times."

"Yes, but we're not big. We don't pay rent, and have no pay-roll, except the little Mason and I take out of the business occasionally."

"It seems to me that it isn't the outgo you should worry about, but the income."

"We're getting a fair share of business, but it doesn't seem to build up the bank account like it should."

"Maybe you need one of those people we used to consider so useless, a cost accountant?"

"We can't afford it yet, Ed, but I told Mason we'd have to open a set of books and either keep them ourselves or have a girl do it at home nights."

"What is Mason's attitude?"

"Well, he thinks that our business is too small still to justify a bookkeeper. He intimated that what I said was following the routine method of conducting a business, but that the book I read was a little ahead of our present needs."

"Then what? Did you let him get away with that?"

"Oh, Mason and I don't quarrel, we discuss things and come to some satisfactory conclusion. If we can't agree, we simply drop the discussion."

"Sounds all right, but if my memory serves me right, I read in my school history about a once great country that was ruined and finally divided among other nations just because its constitution required all decisions of its legislature to be unanimous. No sir, it don't pay to be too considerate. If you think you're right, go to it. There can't be two bosses, even if they are partners. By the way, how come you are getting so considerate all of a sudden. You never were with me; you trampled all over my opinions, and you'd go to the mat with Williams, even if he was your boss. Does being a business man make a pacifist out of you, or is it the fact that it is your own money you're spending that makes you so much more considerate of Mason's feelings than you were of mine?"

"You've got the wrong idea, Ed. I am considerate of Mason's opinions because I like him, and because a firm can't get anywhere if two partners are always fighting. But there may be something in what you say about the impossibility of having two bosses. I can recall many things we've both given up because the other was not enthusiastic about them. Some of them should be done, too. One of them is keeping costs."

"Mason can't keep you from keeping costs if you want to do it yourself, can he?"

"No, he wouldn't say a word, but I want him to see the necessity of it and cooperate. I know there is something wrong with our costs on the compressor. We don't make the net profit we should. Either we omitted some charge we should or else our ideas of cost and charges are wrong."

"Maybe that's the reason you've been selling them so easy, Al. Say! remember that guy named Holland, that spoke before our foremen's meeting once. He said his hobby was advising and helping small firms that were in trouble. Why not write him?"

How early in a firm's existence should a cost system be started? Is too great a desire to be agreeable likely to retard progress?

Discussion

Shall the Customer Furnish Gages?

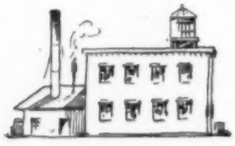
It really depends upon the job. There have been many jobs which would have been much better if the customer had furnished gages, but in this particular instance, Al may quite easily be in the right, and I am inclined to believe he is. Whether Al is right or wrong, it is quite certain that old Tucker is wrong. After the job was finished, delivered, and returned because it was unsatisfactory, was a poor time for him to demand gages. It looks like he was casting about rather desperately for an alibi, and that was the most reasonable one that occurred to him. Unnecessarily close tolerances have one certain result, that of adding to the cost of manufacture, and it may be that this is largely what Al has in mind in making and keeping the allowances liberal. But he may be wrong if he goes too far in his liberality, and may find at a later date that he has courted trouble because parts of machines made at different times will not interchange without extra time and trouble. On the whole, I believe I would be quite willing to furnish the

gages. But I would furnish them elsewhere, rather than to Tucker. The man who peddles his blame once is pretty sure to do it again and again, and it causes one to doubt most everything he has to say. Maybe, for instance, there was a chip on one of the chuck jaws as mentioned, and maybe it is just another excuse. Maybe the boring was done on an old ramshackle machine that should have been on the junk heap, too. It would be interesting to know.

—JOHN E. HYLER.

As Al is not certain that many of the compressors will ever be made and is probably not certain that, if many are made, they will be of exactly the same dimensions as the first compressor, it would be foolish to make gages. He can obtain the same results in slightly longer time by using standard measuring tools to check dimensions.

Before compressor number one was made, no one had thought of the trouble a chip would cause. In the future,



Tucker should be expected to see that this trouble does not occur again, and Al should check for it unless he is positive Tucker has tested the finished piece.

If production ever becomes large enough that gages become worth their cost, Tucker should be either furnished a set or be lent Al's set, as he should be permitted to have a set of gages the same as those Al uses to check him.

Gages will often discover and automatically remedy other troubles. Possibly the rotor bearing on the end of the compressor which was out of true with the bore bound on the rotor, and when the face was trued up, it freed up.

I would suggest that certain dimensions be specified and a large tolerance be allowed. It may then be wise to stamp the over- or under-size on the face of the housing so that repair parts could be easily furnished.

—HERBERT P. HINCKLEY,
President, Herbert Hinkley, Inc.

Measuring instruments are a part of the working tools of the jobbing shop. Tucker is no more justified in demanding a gage from Al than he is in asking Al to send a lathe, planer, shaper or any other tool along with the work. If it is necessary to use special gages during the machining, it is up to him to make them, and if the final checkup of the finished piece requires a gage, he should make this also. He could then say to Al, "Get the business and bring it to us; we are all set to give you first grade work at a price profitable to you as well as to us." But it is up to Al to furnish complete specifications.

Al's attitude on tolerance is beginning to show dangerous signs of weakness. The worry and expense of being a manufacturer is causing him to grope desperately for means of cutting corners. Like all good foremen, he probably has plenty of contempt for draftsmen. But he will find his manufacturing and servicing costs far less, and the marketability of his product considerably greater, if he and Mason get together and work up a set of drawings that thoroughly cover the minutest details, even to the extent of specifying the radii of small fillets and rounded off corners. Their product now is on the market and can no longer be considered as a series of separate machines. The parts must be actually interchangeable. They should use great care in setting limits, leaving enough leeway on all unimportant dimensions to insure greatest economy in manufacture and establishing all important ones from experiments to be carried on in Al's garage on "boneyard" machinery.

Having worked up a manufacturable design and the beginnings of a market, Tucker will not only be willing, but anxious to play the game with them.

—HENRY SCHOLS.

Dear Al:

I am sorry to see that you have made your first mistake.

How are you ever going to be able to furnish repair parts for the compressor that was doctored up on account of old man Tucker's not boring both ends parallel.

Tucker is right—you should furnish gages. Some day you will do all the work yourself, and gages will be mighty handy to have. You cannot expect a satisfactory article to be tailor made.

If anything goes wrong with it your customer will want repair parts that will fit when he gets them. You must work to gages, so you can duplicate all parts.

Get it out of your head that your product is different. If you expect to do business you must do the same as other successful manufacturers — work to standards, use gages and remember that what you make will not last forever. You can only expect to get repeat orders if your product is satisfactory. It is true that gages cost money, but you can make the most important ones first, and keep adding until you have a complete set. You will save in the long run, the extra work done on the first job that went wrong would have paid for the required gage.

—CHARLES RINKER.

Slightly Worn

Without knowing that the purchase of a machine, new or second-hand, would cure his troubles, Al would be making a gamble rather than an investment. This is particularly true where he apparently plans to do work on the machine that that machine was not specifically designed to do and when he can probably find plenty of idle machines of the right type in various jobbing shops.

Instead of investing in machinery, Al should so perfect his design that the parts could be accurately made on the machinery available in job shops. If he puts his money into machinery and it does not cure his troubles, he is out of luck. If he cures his troubles first and sells some compressors he will have some money available to spend for machinery.

As a general rule machinery bought for replacement of an old machine and to be used steadily on production work should be new. There is little justification for replacing one used machine with another.

Where the operation is new and its future doubtful or the production limited, the purchase of used machinery permits a smaller investment. If the job does not pan out the loss is smaller as the resale value of the machine is higher in proportion to its first cost. If the job is a success, information pertinent to the purchase of a new machine has been cheaply acquired.

—WILLIAM A. WALTER.

Is This a Good Time to Quit?

So Al is going to quit and start in for himself. It takes intestinal fortitude to quit a job and start out for oneself at any time—more so at this time. He has had plenty of experience. He should know costs. In fact, he should now have everything a man needs after these years, excepting just one thing: Has he the wife that has confidence in his ability and who will go with him every step of the way? Has she the same fortitude that Al has, or will she kick, growl and chew the rag every time he is in the house. When Al comes home half discouraged and tired, will she say: "Cheer up old man, things will come out all right"? Or will she find fault because she cannot go to the movies. If she is the first type, Al will succeed. If she is the latter type, he can never succeed.

—C. G. WILLIAMS.

American Machinist
Reference Book Sheet

Torque Required to Tap Cast Iron

SUMMARIZED are results of tests conducted at the Engineering Experiment Station of the Iowa State College to discover the torque required to tap cast iron, using National coarse and fine-thread series taps. This is the first material reported in a study of the torque requirements of taps in different materials and varying conditions.

Taps employed in these tests ranged from 12-24 to ¾ in.-10, and from ¼ in.-28 to ¾ in.-16. Three series of tests were made covering thread depths of 50, 75 and 90 per cent. Curves are presented showing the torque requirements for the three depths of threads. An equation for the torque in terms of the major diameter, the per cent of thread and the number of threads per inch is included and is plotted.

The taps were supplied by four manufacturers and were designated as follows: Nos. 1, 2, 3 and 4, plug-style taps. These were of carbon steel with cut threads. Taps 5 and 6 were the taper style, cut thread, carbon steel. No. 7 was a plug style tap of high-speed steel with cut threads. Taps 8 and 9 were plug style taps of high-speed steel having threads ground to form. Tap 10 was a taper style, high-speed steel, ground thread. No. 11 was a plug style tap, carbon steel, cut threads, with flutes advancing in the direction of rotation.

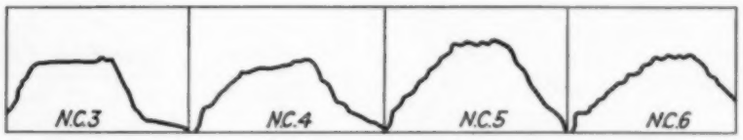
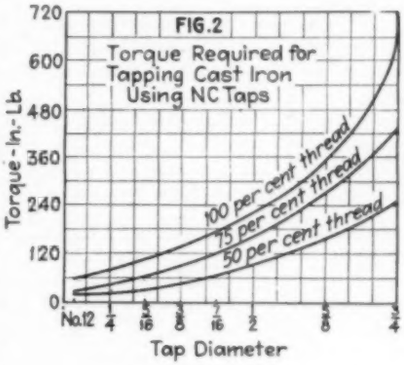


FIG. 1



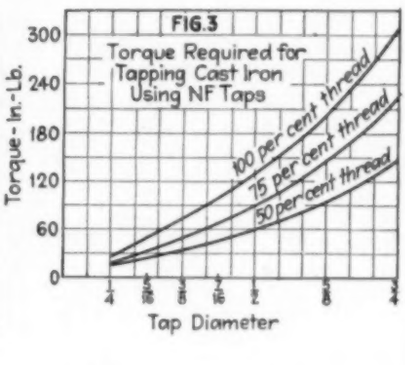


TABLE 2

Torque for ⅜-In.—16 Taps in Cast Iron

Drill Size	% Thread	NC 4	NC 6	NC 7	NC 9
8.5 mm.	49.7	43	54	42	52
8.4 mm.	54.5	47	58	44	53
8.3 mm.	59.3	52	62	47	58
8.2 mm.	64.2	55	65	55	62
8.1 mm.	69.0	62	69	58	68
8.0 mm.	73.8	64	75	63	73
7.9 mm.	78.8	72	77	71	82
7.75 mm.	86.0	77	90	80	92
N	89.8	84	94	85	100
17/32 in.	96.2	95	99	100	109
M	98.4	97	102	102	113

No chemical analysis of the iron was obtained. It is known, however, that it contained a high amount of phosphorus and was low in silicon and manganese. Total carbon was probably 3 or 3½ per cent, with not more than 0.22 per cent of combined carbon. Brinell hardness was 170.

Each hole was drilled twice, first to a diameter slightly smaller than the one desired, and then redrilled with the correct size. The formula, $DM - 1.3 \times$ per cent thread $\times P$, was used to compute the desired hole sizes. D is the diameter of hole, M the major diameter of the tap (outside diameter), and P the pitch of the thread. Table 1 gives the drills used. Table 2 gives torque results for a depth of thread varied by 5 per cent intervals over the range from 50 per cent to full depth. The investigation was carried on for all taps with the spindle turning at 125 r.p.m. Torque required for tapping each hole was recorded by the ordinates on an indicator card. Sample cards obtained from ⅞ in.-14 taps are shown in Fig. 1.

Curves representing the average of the torque taken by all taps in the National coarse-thread series is shown in Fig. 2. Similar data for the fine thread series were plotted in Fig. 3. These curves suggested the equation:

$$T = F\left[X\left(\frac{R - \frac{X}{2}}{8N}\right) + X \tan 30 \text{ deg.}\left(R - \frac{2X}{3}\right)\right]$$

T is the torque in in.-lb., R the nominal radius to the crest of the thread or one-half the major diameter, N the number of threads, and

$$X = \frac{0.6495}{N} \times \text{per cent of thread.}$$

From a paper by J. Edward Miller presented before the Machine Shop Practice Division, A.S.M.E., Buffalo, Oct. 3, 1932.

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Reference Book Sheet

Torque Required to Tap Cast Iron

Examination showed the foregoing formula to apply fairly well, but F was not constant. Using the data in Table 2, the relation for F was found to be:

$$F = \frac{K}{[100(\text{per cent of thread} - 0.38)]^{0.20}}$$

and the above formula becomes:

$$T = \frac{K}{[100\ (\% - 0.38)]^{0.20}} \left[X \left(R - \frac{X}{2} \right) \frac{}{8N} + X \tan 30 \text{ deg.} \left(R - \frac{2X}{3} \right) \right]$$

For taps of the National coarse-thread series, the value K is about 1,116,000 and for the National fine-thread series 1,410,000.

TABLE 1

American Standard Coarse-Thread Series—Tap-Drill Sizes						
Tap Size	Drill	% Thread	Drill	% Thread	Drill	% Thread
12–24	10	92.2	16	72.0	12	50.0
¼–20	13	100.0	7	75.0	1/32	48.1
5/16–18	C	97.6	F	76.8	J	49.1
3/8–16	M	98.4	5/16	76.9	Q	52.9
7/16–14	S	96.4	U	75.0	23/64	50.4
½–13	Y	96.0	21/64	78.1	27/64	46.9
5/8–11	33/64	92.5	17/32	79.2	9/16	52.9
¾–10	5/8	96.1	21/32	72.1	11/16	48.1

American Standard Fine-Thread Series—Tap-Drill Sizes						
Tap Size	Drill	% Thread	Drill	% Thread	Drill	% Thread
¼–28	6	99.1	7/32	67.3	1	47.4
5/16–24	G	95.8	I	75.0	9/32	52.7
3/8–24	P	96.0	Q	79.4	S	50.0
7/16–20	3/8	96.1	25/64	72.1	Y	51.5
½–20	7/16	95.1	29/64	72.1	13/32	48.1
5/8–18	9/16	86.5	33/64	67.6	37/64	48.6
¾–16	43/64	93.1	11/16	76.9	45/64	57.7

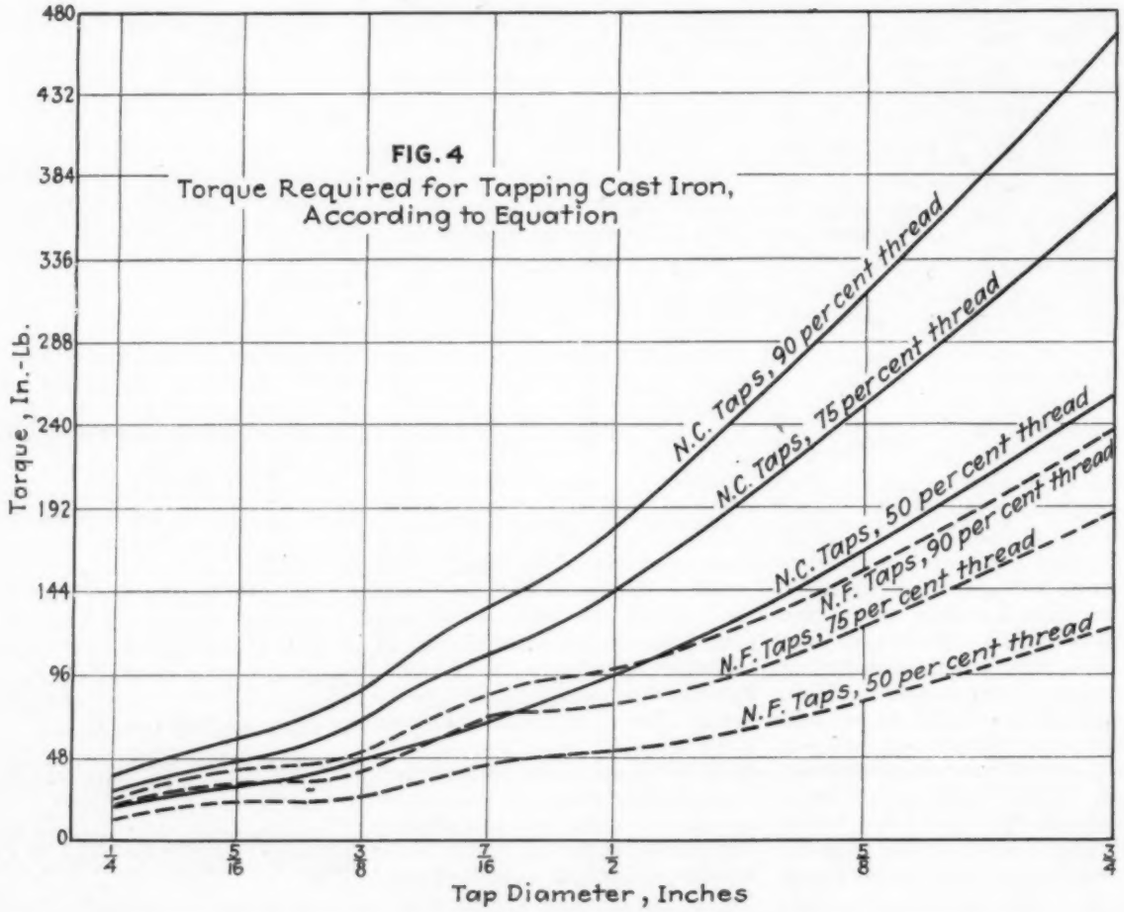

FIG. 4
Torque Required for Tapping Cast Iron, According to Equation

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• IDEAS FROM PRACTICAL MEN

A Rotary Stamp for the Screw Machine—*Discussion*

F. L. GILLETT

Referring to the simple device for stamping round work in the screw machine described by Herman A. Myers in an article under the title given above (*AM*—Vol. 76, page 564), I want to express my commendation of the method employed as being both speedy and efficient. Also, I would like to submit a description of a similar device that has the added feature of using interchangeable stamps that can be set up like type to produce any word or number.

The assembled stamp is shown in the illustration. The stamps themselves are purchased from a manufacturer and have rough shanks approximately $\frac{3}{4}$x$\frac{3}{8}$ in. We finish the shanks to the size and shape shown at the right in the illustration. The work is done by grinding, using fixtures and gages.

In use, with the work running at about 30 ft. per min. and the stamp held in the front toolblock, the operator rotates the stamp wheel until the blank part is opposite the work. He then feeds the stamp in until any part of the blank segment contacts with the work, letting the stamp rotate by friction. After the stamp has made approximately one revolution, the operator withdraws it, leaving it automatically in position for the next piece of work.

For some work we have small monogram stamps that are inserted in the holder along with trade names and part numbers, and we find it quite easy to change the part number when making a new part.

Special Crane Chains and Bar

W. J. TANGERMAN

Shop Superintendent, Union Metal Products Co.

In the manufacture of corrugated ends for freight cars, the rough corrugated plates are stacked or piled. In various of the punching and shearing operations, the stack must be set on edge, laid flat, or turned over. This operation always offered considerable trouble, often requiring three or four changes of hooking before the desired effect was obtained and consequently tying up the overhead cranes for considerable periods.

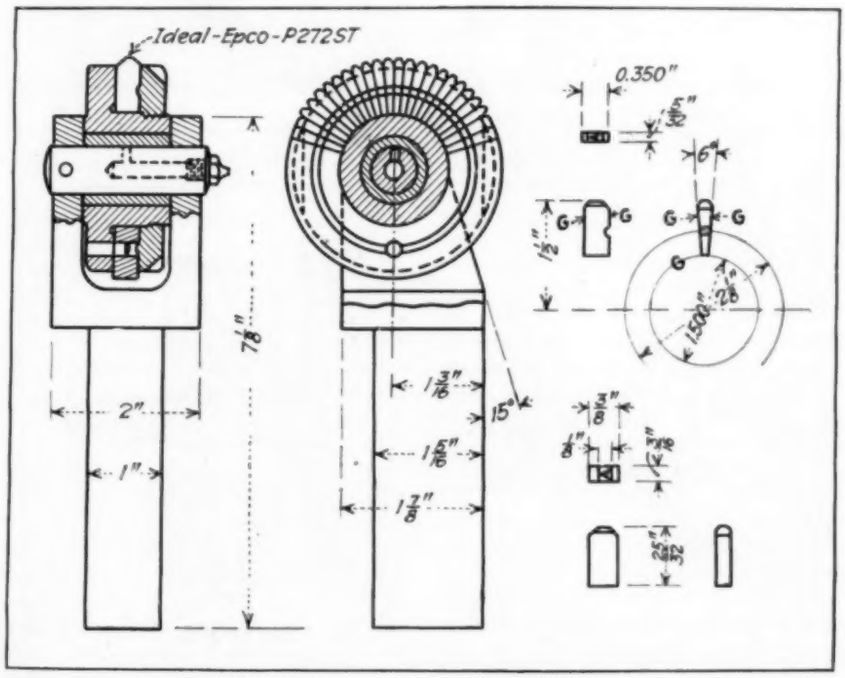
Our solution to the problem is illustrated. It is simply a heavy section of archbar steel with chains running from each end to a center ring that engages the crane hook. At either end of the bar is a double U which supports a roller-bearing pulley wheel, over which an endless chain operates. Now it is possible to up-end a stack of plates without delay, often while they are in motion, the hookers being able to tip them with but slight pressure. This saved considerable time in handling.

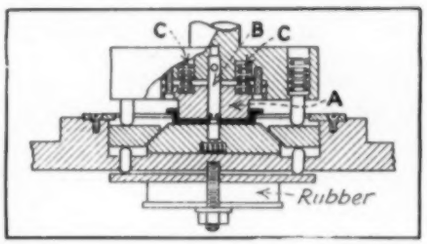
Squaring Studs in Sheet-Metal Bases—*Discussion*

CHARLES KUGLER

At the end of his article under the title given above (*AM*—Vol. 76, page 680), Charles H. Willey says, "I am wondering if there is not a better way to fasten the studs so that they will not deform the bases." From my experience in the class of work described by Mr. Willey, I have found that riveting such work in the punch press is a better method than spinning, except where the parts are very delicate or frail.

If Mr. Willey will make the holes in his anvil so that the studs will bottom when their shoulders are flush with the surface and will substitute the spring-actuated pressure pad *A* for his squaring punch, and put in the riveting punches *B* (one only of which is shown) as indicated in the accompanying sketch, he can then use the tools for riveting the studs in the press. The cost of these changes will be small and the production will be increased, as but one





operation will be necessary, and riveting in the press is faster than by spinning.

In operation, as the ram descends, the pressure pad *A* contacts with the base and sets it square with the studs. Continued downward movement of the ram compresses the springs *C*, causing the pressure pad to remain stationary while the punches rivet the studs.

Press Tools for Forming Lugs on the Insides of Shells

EUGENE L. SOLTNER

We had an order for a large quantity of bottlenecked shells to have six lugs on the insides. The lugs were to be in two planes in groups of three. After drawing the shells in the usual manner, the lugs were formed in the rather unusual tools shown in the illustration.

The horn die *A* is held in the ring *B*, while the sliding punches *C* and the springs *D* are held in the rings *F* and *H*, all the rings being attached to the bolster by screws. Slipped over this assembly is the sleeve *K*, to which the cams for operating the sliding punches are secured. This sleeve is held in place by the ring *L*, which is connected by a lever and a rod to the press ram and oscillates as the ram moves up and down.

A novel means is used for securing the horn die in radial adjustment with the sliding punches, and which permits rotary adjustment to that end. A slot is milled across the face of the part *M* into which a tongue on the ring *N* engages. The inside of ring *N* is tapered and into it is fitted the ring *O* having a rectangular hole in which the flatted shank of the horn die engages. The rear end of the horn die is threaded for the nuts *P*. Tightening the nuts draws the tapers on the rings *N* and *O* together and draws the shoulder in the center of the horn die against a shoulder in the ring *B*, locking the assembly securely. Slackening the nuts releases the horn die and permits it to be rotated to align it with the sliding punches.

In operation, a shell is placed on the horn die and is located and prevented from turning by a notch in its end engaging the key *S*. As the ram descends, the ring *L*, which is connected to the ram by a lever and a rod, is given a partial turn, carrying sleeve *I* with it. As sleeve *I* turns, the cams attached to it move the punches inward radially, lancing the shell and forming the lugs. As the ram ascends, the receding cams permit the punches to be withdrawn by the springs *D*. Since the horn die is grooved in line with the lugs on the shell, the shell can be removed without interference.

A Specially-Graduated Scale

WALTER WELLS

Suggested by certain features pertaining to metric graduations, but in no other way related to the metric system, a scale graduated as shown in Fig. 1 aided the output of a certain shop. A lot of shafts resembling the one in Fig. 2 were to be turned. No two of them were alike in all dimensions, because of engineering requirements of work that was in a semi-experimental stage. Mismeasurements caused by puttering around with scales graduated to $\frac{1}{32}$ and $\frac{1}{64}$ in. could not be tolerated, since it resulted in the waste of valuable material (stainless steel), labor, and especially, time.

The features of the scale are: The smallest of the divisions are plainly distinguishable from one another without a magnifying glass, permitting "splitting" the line; the reading in whole numbers and simple fractions, which aids in checking several dimensions together; the facility with which calipers can be rapidly and surely set for roughing cuts; the long lines on the $\frac{1}{16}$-in. graduations (the $\frac{1}{16}$ and 1 in. being excepted for contrast) permit Instant interpolations from the $\frac{1}{16}$-in. graduations when reading conventional drawings; and the subdivision of the $\frac{1}{16}$-in. graduations into four divisions, making for quick reading as compared with the five divisions in straight decimal graduations. By this method, the graduations are the same as the ones on the barrels of micrometers. Incidentally, when using a scale so

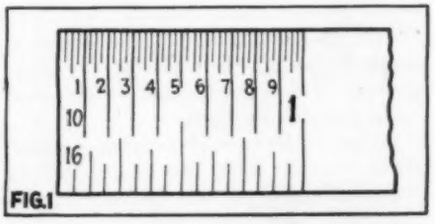


FIG. 1

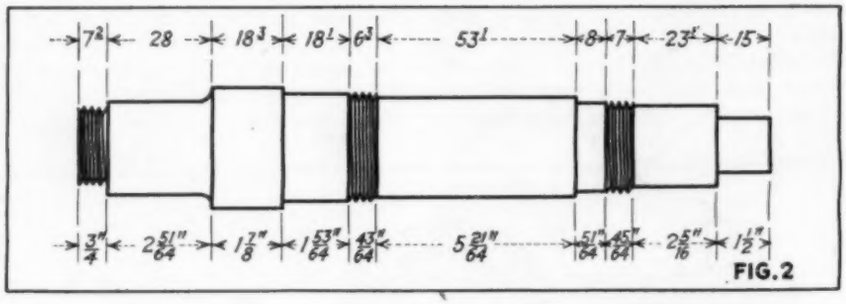
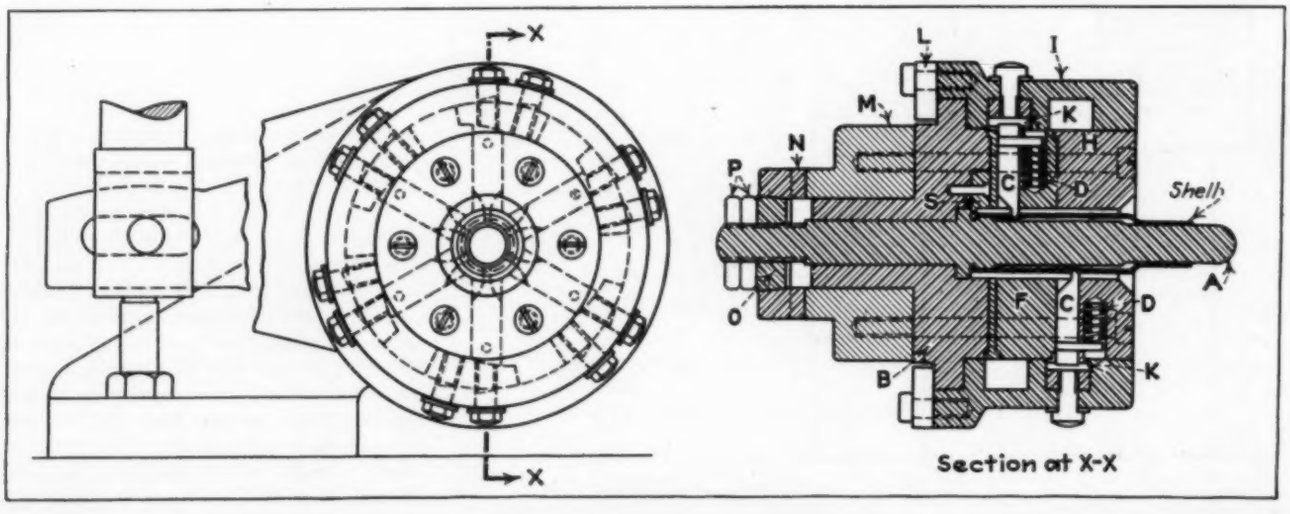


FIG. 2



graduated, apprentices might learn their decimal equivalents more quickly.

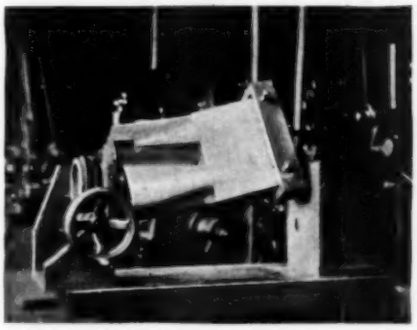
In the particular shop referred to above, the engineer cooperated by stating all his dimensions in tenths of an inch and quarters thereof. This was a simple enough procedure for him. He simply moved his decimal points one place to the right and then forgot about it. Note the contrast of the dimensions at the top of the shaft in Fig. 2, as taken from this scale, with those at the bottom, as taken from a conventional scale. No doubt there are but few jobs that have so many cumbersome fractions. But this one had, and it gives an idea of the cumulative errors that may creep into many jobs.

Machining a Circular Taper on the Shaper

A. W. HACKER

Foreman, Machine Shop,
Union Metal Products Co.

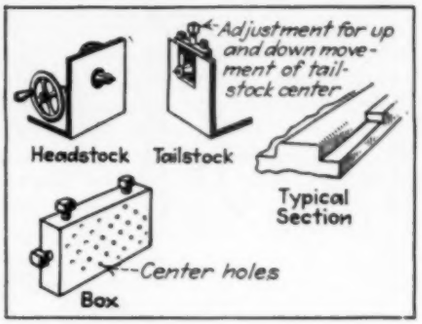
We have a number of jobs similar to that shown in position below, in which a tapered circular section requires machining. We had tried various methods from time to time, but none seemed to be universally applicable or particularly



convenient, until the fixture illustrated was constructed.

It is composed of three parts, a headstock with worm attached to a handwheel and gear driving a center and dog; a tailstock carrying only a center; a box with setscrews on its four sides and a number of center holes drilled in its back. The head and tail stocks are formed of discarded angle plates; the box is welded up of sections of steel plate. The tailstock, as shown in detail, has a center adjustable for height.

The cast block to be machined is fastened within the box in such a way that one of the center holes in the box is the apex of the portion of a cone which is to be machined. A center hole is drilled in the opposite end of the block itself, and it is then swung between centers with the U-shaped dog put over



its end for driving purposes. The wormwheel is then used to swing the block as the shaper machines the sides of the taper. In the block illustrated, the cone has a flat surface on the edge toward the camera, consequently two centers are used in the base, one for each rounded contour.

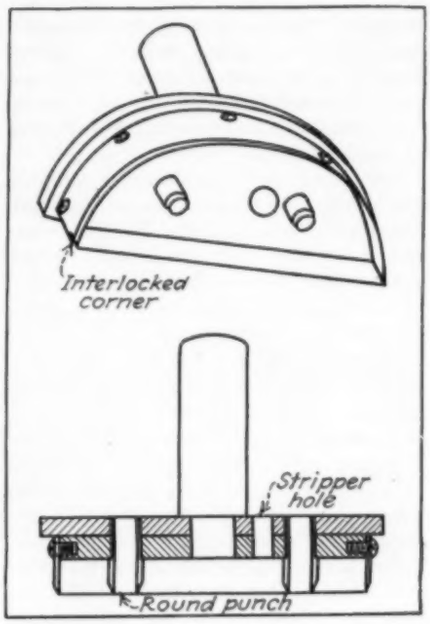
A Sectional Dinking Punch

D. J. REYNOLDS

Draftsman,
Kelly Koett X-Ray
Manufacturing Company

Electrical manufacturers often require punchings of paper or thin fiber to be used in the insulation of coils. When production is limited to small lots at intervals, the cost of the usual press tools and of stocking the parts is prohibitive. Under these conditions, a small investment in a dinking punch will often prove profitable. Round dinking punches have long been used, but owing to the thin, sharp edges necessary, the punches are easily damaged, and the cost of making or sharpening a solid punch of irregular outline may often exceed the cost of the usual die set.

The construction of the dinking punch illustrated has proved economical. The body plate is cut to the outline of the part to be made and the cutting parts are made from thin steel such as is used for the springs of phonograph motors, and are bound to the body by small machine screws. The spring steel is purchased already hardened and the edges are ground before fastening it to the body plate. When holes are wanted in the blank, ordinary round dinking punches are pressed into the body plate. After several blanks have been punched, they can be stripped from the punch by pushing a screwdriver through a hole in the body plate. For more complicated blanks, a spring stripper may be built into the punch. Should the steel cutters be damaged, new ones are easily made, using the old ones as patterns. Since there are no setting-up charges for these hand tools, the cost of the punchings is about the same for small lots as for large ones.

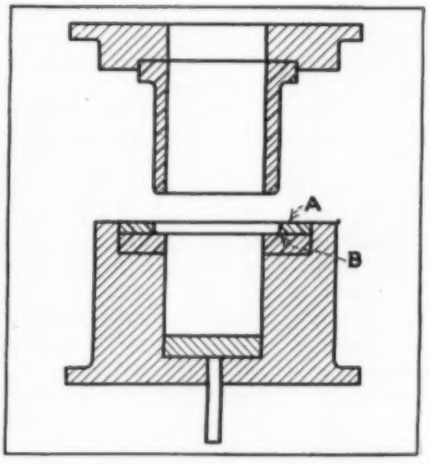


Drawing in a Single-Action Press—*Discussion*

JOHN J. MC HENRY

The press tools described by Wm. C. Betz in an article under the title given above (*AM*—Vol. 76, page 834) show the possibilities of producing a difficult stamping in dies of very ordinary design. I was particularly interested in the second operation in which the shell is reduced without a blank holder or inside support of any kind, but the description would have been more interesting if the part had been dimensioned. It might also save some designer from getting into trouble by attempting such a reduction on an impossible diameter.

As another instance of the peculiar action of a shell being reduced, the accompanying sketch will serve as an illustration. Here are shown the blank holder and the die for reducing a shell



0.040 in. thick and 4 in. in diameter, having a corner radius of $\frac{3}{8}$ in. Unless having it brought to their attention, most designers and diemakers would bore out the nest ring *A* straight, thus leaving a sharp corner at *B*. It is natural to expect that in the reducing operation the metal would flow down and around the corner radius of the blank holder, but it is a fact that it will not. Different sections of the shell periphery will draw down in a square corner, a great percentage kinking sharply and either breaking or seizing. The nest ring must have a corner radius as shown at *B*, the same as the shell radius.

It has been our experience that to attempt to reduce shells of approximately two inches or over without inside support is disastrous. The shell will collapse, form large wrinkles and will not only draw, but in all likelihood will ruin the die. Metal thickness, and whether or not the shell is to be reduced or reversed, are important factors. I would like to have some one tell how to determine mathematically at what diameter a shell of stated thickness will redraw to a required reduction without inside support.

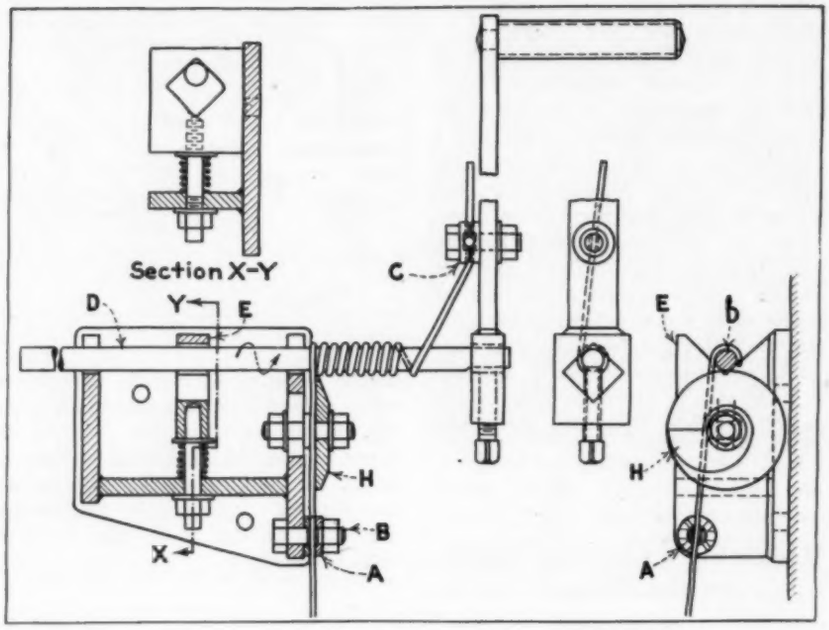
Fixture for Winding Springs

HEINRICH WITMER

When a comparatively small quantity of helical springs is needed, this fixture will be found satisfactory for winding them. It is inexpensive to build and will wind either push or pull springs, right- or left-hand, of various pitches and from wire of different sizes.

In winding springs, the wire is drawn between the two washers *A*, through a clearance hole in the bolt *B*, and the end is securely gripped by the washers *C* on the crank. Both sets of washers have half-round grooves across their faces for wire of different sizes. The mandrel *D* rests in V's formed in the ribs of the fixture body and is drawn into the corners by the spring-actuated holder *E*. Both the holder and the crank have square holes to accommodate mandrels of various diameters.

In order to coil the wire tightly around the mandrel, sufficient tension is provided by pulling the washers *A* together by the bolt *B*. As shown in the view at the right, the disk *H* is beveled helically on one side to form an edge that varies from zero up to the full thickness of the disk. This edge is brought into contact with the mandrel and the disk is locked by a bolt. The spacing, or pitch, of the spring can be varied by rotating the disk to bring thinner or thicker parts of its edge into contact with the mandrel.



At each revolution of the crank, the wire passing over the edge of the disk forces the mandrel to travel in the direction of its axis a distance equal to the thickness of the edge of the disk. To allow for subsequent enlargement in diameter and shortening in length of the springs when the tension of winding is released, due to the spring of the wire, springs should be wound somewhat under the diameter required and should have two or three extra turns. The fixture is attached to the bench by bolts through holes in the base.

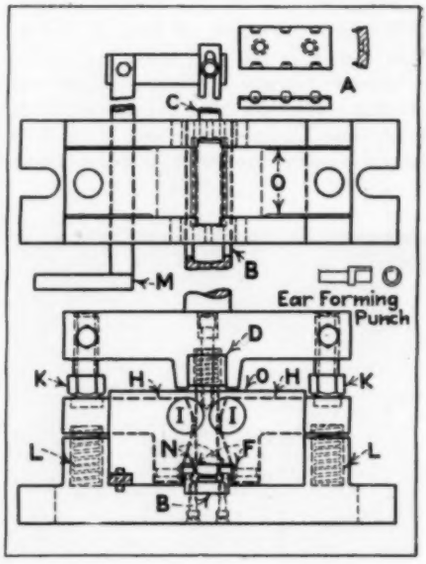
Press Tools for Forming Ears on Contact Segments

ANDREW BEUSCH

The tools shown in the illustration are for forming ears on the sides of contact segments for wooden controller drums, one of the completed segments being shown at *A*. The blanks are sawed from a flat bar of copper of the correct width and thickness.

In operation, a blank is slid in the channel of the locating block *B* and against the adjustable stop *C*. As the ram descends, the spring-actuated plunger *D* contacts with the blank and holds it firmly. As the ram continues its descent, the side punches *F* are brought into action, indenting the sides of the blank and pushing the surplus metal against the sides of the spring-actuated plunger and forming the ears.

The side punches are attached to the bell cranks *H*, which are pivoted at *I* and are operated by the plungers *K* striking hardened plugs in their ends. Just before the side punches come into action, the spring-actuated plunger has



compressed its spring and, coming against a stop, its rounded lower end rounds the blank to the required radius, the bottom of the channel in which the blank rests being concave.

On the upstroke of the ram, the ends of the bell cranks are raised by the springs *L*, withdrawing the side punches. When the ram nears the end of its upward stroke, the spring-actuated plunger is lifted from the blank which is ejected by pulling forward the lever *M*. This lever is connected to the stop *C* by a rod and pulls it forward against the rear end of the blank. Thus the stop serves both as a stop and as an ejector.

In assembling the controller, the ears on the segments are driven into the wooden drum by a raw-hide mallet, preventing the segments from slipping while the holding screws are applied. The

tools are shown in the down position of the ram. Each bell crank carries three side punches. The pins *N* in the side plates *O* strip the blank from the spring-actuated plunger as the ram ascends.

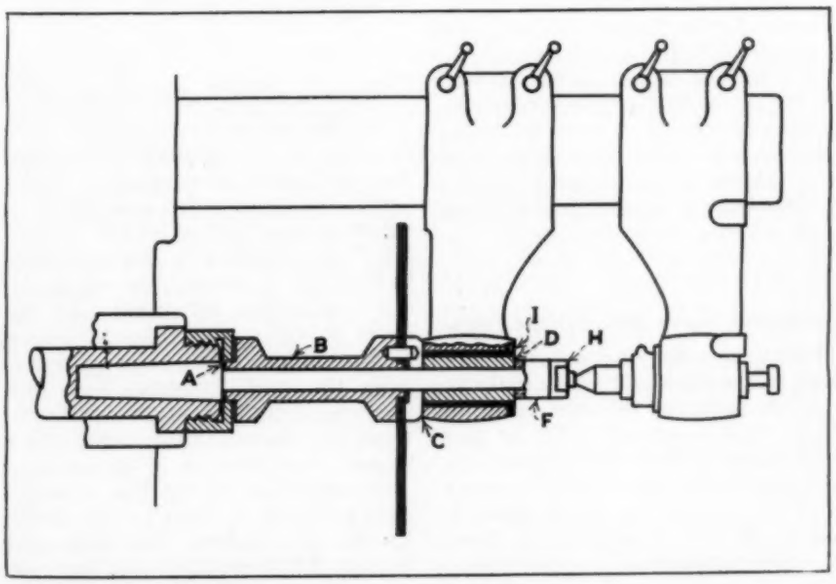
Drive for a Slitting Saw

ROBERT D. ZIMMERMAN

Having to do a great deal of deep slitting in both cast iron and steel to obtain test bars from the ends of large shafts and sections of machine parts, the drive for the saw was made as shown in the illustration. This drive was found to be superior to the usual one where the saw is clamped between collars on an arbor. The few parts required comprise a drive for the 3-pin type of saw, such as the familiar Nutter & Barnes.

The assembly consists of an old milling arbor having the shoulder cut back to *A;* the spool *B;* the cap *C* to hold the saw in place; the hardened steel bushing *D;* the arbor collar *F;* and the arbor nut *H*. The inner end of the spool abuts the shoulder *A* of the arbor and has a tang engaging the slots in the driving collar of the machine. At the other end the spool is turned down to fit the hole in the saw. Three pins driven in the face of the shoulder are used to drive the saw, which is held against the shoulder by the cap, under pressure of the hardened bushing through the collar and the nut on the arbor. Ordinarily the outer support would not be necessary to prevent the arbor from working loose in the spindle, but in this particular machine the brass bushing *I* had its flange on the wrong end to provide a thrust bearing for the cap.

Although the set-up was intended for use when a saw of large diameter was necessary, it was found advantageous to use large saws on many jobs where smaller saws could be used, and also where a wider kerf would not be objectionable, because with such a set-up all the obvious advantages of large saws, particularly slower dulling, could be secured with no attendant difficulties. I have used saws as large as 15 in. in diameter and have made cuts as deep as 5½ in. in cast iron and 4 in. in steel of from 0.30 to 0.40 per cent carbon. The saw was run dry in cast iron, but one of the well-known soluble oils was used as a lubricant for the steel. A saw with inserted teeth of high-speed steel has been found superior to the solid saws of carbon steel.

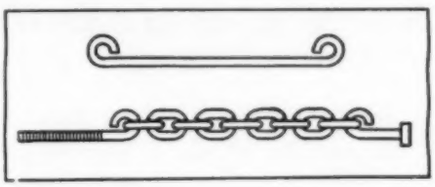


An Improvised Extension Bolt
Discussion

JOHN E. HYLER

The extension bolt described by John Aures in an article under the title given above (*AM*—Vol. 76, page 913) is all right, but I prefer the one here illustrated.

A bolt is cut in two and the ends are bent into eyes and connected by a piece of chain, or by a link such as is shown at the bottom of the illustration. Where a long bolt is to pass through two holes that can not be brought into correct alignment, there is enough flexibility in the bolt described to take care of considerable misalignment.



There may be cases where a bolt having a head on one end can not be used. In such cases the threaded ends cut from two bolts can be used, two nuts, of course, being necessary. Where a great amount of strain is to be borne by a bolt of this type, it will be well to weld the eyes shut, thereby adding considerable strength.

Closer Limits in Layout Work

HART F. WRIGHT

Where it is not convenient to use a height gage, close layout work often depends upon accurate setting of dividers. Since scales are divided in 32ds and 64ths of an inch, or in metric divisions, it is necessary at times to use some method by which dimensions falling between these divisions may be correctly registered.

It is possible to divide almost any dimension into two parts, one of which can be found on a scale, while the other is divisible by 0.025 in. As, for instance, the dimension 0.8062 in., which can be divided into $\frac{31}{64}$ and 0.025 in. To set the dividers to this dimension, set them first to $\frac{31}{64}$ in. on the scale. Then, with one point coincident with one of the 0.025-in. lines on the barrel of a micrometer and the other point held firmly in place, raise the first point carefully and open the dividers until this point coincides with the next 0.025-in. line.

If the dimension required is too great for the whole of it to be recorded on the barrel of the micrometer, as for instance, 3.9625 in., set the dividers to $3\frac{7}{8}$ in. on the scale and step this distance off on a line. Then set the dividers to 0.400 in. on the micrometer barrel and add that distance to the line. Then, by adjusting the dividers to the total length of the line they will be set to 3.9625 in. A still more accurate method for these longer dimensions is to set the dividers to, say, $3\frac{13}{32}$ in. and then using the scale of a vernier instrument, place one point coincident with one of the 0.025-in. lines. With the other point held firmly in place, raise the first point and advance it to the next 0.025-in. line, giving a total of 3.9625 in. Substraction as well as addition may be used in this system.

It is, of course, necessary to use a good magnifying glass in these operations. It is also necessary to use a wiggler in the drill chuck to get the line intersections directly under the center of the spindle. By application of the methods described, the writer has laid out many jobs and after drilling and reaming the holes, has seldom found an error as much as 0.002 in. in center dis-

tance. This is plenty close enough for many of the jigs and fixtures in use in most shops. Intelligent use of this system makes it possible to save much time on jobs that do not have to be right "on the money," but that would otherwise require elaborate set-ups, either on the jig borer, milling machine, or lathe, with possibly one or more buttons to be placed for starting points. if not for each hole to be bored.

Tools for Quenching Machines

D. L. BROWN

To prevent the races of roller bearings from changing shape while being machine quenched, they are put in the die *A*, Fig. 1, which is recessed in the center in two steps. The higher step serves as a nest for locating the work, while the lower step acts as a stop for the holding plunger, the construction of which is as follows:

The shank of the conical plunger is screwed into the ram of the machine and is held in correct adjustment for height by locknuts. The expanding bushing *B* is in six segments, all of which are normally held in contact with the conical plunger by retaining springs set in grooves at both top and bottom. Before being cut into segments, the bushing is ground to fit the conical plunger, the lower ends of both members being ground flush. The coil spring *C* normally holds the inner shoulders at the top of the segments against the upper shoulder of the conical plunger, permitting the segments to contract when the plunger is raised.

When the plunger is down in contact with the lower step of the die and the bushing has expanded to fill the hole in the work, the quenching water is turned on. It passes through the hole *D* in the die-holding fixture and into the opening *F* in the die, reaching the inside of the work through the grooves *H* cut in the segments of the bushing. Also, it passes through the holes *I* in the fixture, from where it is sprayed on the outside of the work.

For races having tapered holes, the conical plunger itself fits the work, no expanding bushing being necessary. This plunger, shown in connection with the die in Fig. 2, has slots in its sides and radial holes *K* connecting each slot with the water passage *M*. The raised shoulder on the die acts as a stop for the plunger and also centralizes the work. The slots *N* in the die provide passage for the escaping water to reach the under side of the flange on the work.

At least one quenching machine is provided with two rams and two sets of tools. When one ram is in the down position, the other one is at the top of its stroke, permitting work to be loaded in the die beneath it. Another feature of this machine is that the quenching water is turned on automatically as soon as the plunger contacts with the die.

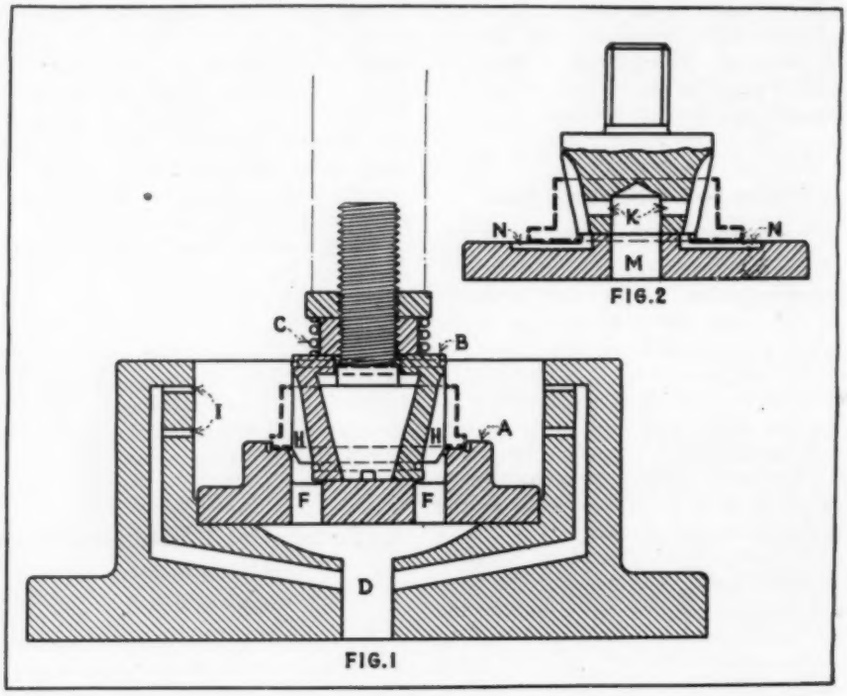


FIG.2

FIG.1

SEEN AND HEARD

JOHN R. GODFREY

Concentricity Looks Easy, But—

Concentricity of two or more diameters isn't as easy to get in the shop as on the drawing. This is especially true where the different diameters must be secured by reversing the piece in the lathe or where a thread is desired, truly concentric with the plain diameter, as with a body-fit or a body-bound bolt. It is not easy to chase a thread truly concentric and when it is cut with a die, this becomes almost impossible. The usual solution is to make the thread diameter enough smaller than standard to allow for the eccentricity.

Increased Screwdriver Efficiency

Slightly rounding the end of a well fitting screwdriver will add greatly to its ability to stay in the screw slot when heavy stress is applied. This is particularly true of very short screwdrivers when used for starting obstinate screws.

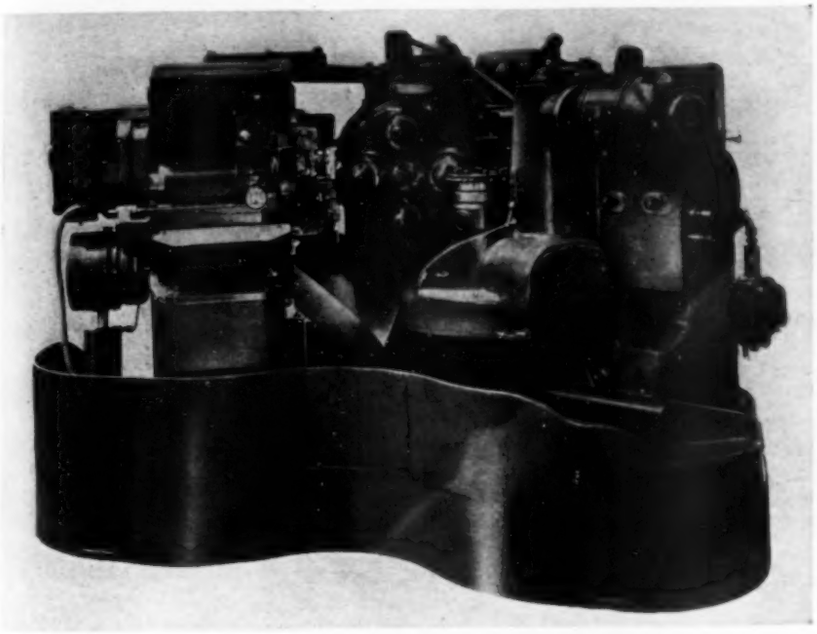
When a screwdriver with a straight, square end is used under heavy stress, the sidewise motions of the user's hands cause the screwdriver to rock back and forth, bearing first upon one corner, then upon the other. This action causes the opposite corners of the screwdriver end to be raised more or less from the screw slot. With the screwdriver in this position, the corner of the blade shears more or less metal from the edge of the screw slot. This action is cumulative and soon ruins the screw slot.

When a screwdriver has a slightly rounded end, it will stay in the bottom of the slot under most conditions. There are no corners for the screwdriver to fulcrum upon, consequently some portion of the rounded end is always in the bottom of the screw slot. A rounded screwdriver will also enter a slot more readily than a square-ended tool which is important when working in the dark.

Drawing Metal at High Speed

The flow of cold metal was formerly considered to require plenty of time and drawing operations were slow. Years ago I saw copper tubes squirted in an old screw press. When it broke down a crank press was used by slowing it down to 30 strokes a minute. This was gradually increased to 120 strokes and the metal flowed as well as at 30. Brass shell for large cartridge cases are undergoing the same transformation. Not long ago 15 ft. a minute was the usual speed for drawing these shells. Now they are being drawn at 180 ft. a minute. And instead of ruining the metal, as some predicted, it seems to have better qualities than before. The work must be kept fairly cool, but not too cool.

SHOP EQUIPMENT NEWS



Gleason No. 9 Completing Generator

Rough and finish cutting of differential gears and pinions is done on the No. 9 completing generator announced by the Gleason Works, 1000 University Ave., Rochester, N. Y. These operations were formerly done on two separate machines. The company states that the following advantages are obtained by combining the operations: Elimination of one chucking and dechucking operation; elimination of stock dividing; elimination of the handling and moving of roughed out blanks; automatic chucking and dechucking of blank, eliminating the manual type which causes fatigue of operators; blanks are placed on spindle while machine is in production at two other stations; decreased cutter and tool cost; decreased floor space and decreased maintenance cost.

Roughing the teeth is accomplised with an inserted formed blade cutter, while the finish cutting is done by the generating method using two reciprocating tools. All power-driven shafts on the roughing, finishing and main machine drives are mounted on anti-friction bearings. Spiral bevel gears are used throughout.

The machine is loaded manually by placing a blank on the spindle in the uppermost or loading station. The blank is automatically secured in place and the turret advances it to the roughing station. The blank is next roughed and when this operation is completed the turret advances to an intermediate station and then to the finishing station. After finish cutting, the turret advances the pinion to the loading station where it is released automatically and removed manually. Thus, one finished gear or pinion is obtained for every 90 deg. of index of the turret drum. The machine is arranged to prevent the completed gear or pinion from proceeding through the cutting cycle a second time.

The roughing cutter is fed into the blank traveling at right angles to the root line. This is controlled by a hardened cam. The cutter is withdrawn and the blank indexed to the next tooth until the blank is completely roughed. The cutter spindle is mounted vertically on anti-friction bearings with a large balance wheel to obtain smoothness of cutting. Cutting speed can be varied from 104 to 202 ft. per minute through change gears. The whole unit is mounted in a large cross rail.

On the finishing unit, the generating motion is divided between the tools and the work. Relative rolling between the tools and the work is obtained by a crown gear and segment, the latter being of suitable pitch angle for the gear or pinion being cut. A large double gibbed cradle is oscillated in its housing by a cam to provide the generating roll. Tools used have the cutting effect of side tools, producing a smooth finish on the profile of the teeth. These tools are withdrawn from the work at the top of the roll after each tooth is finished to permit indexing. Tool slides are reciprocated by a crank plate. The driving sections are arranged for producing a draw cut. The feed motion to the tool carriage is imparted directly through a cam. An overhead tie between the cradle housing and turret housing provides rigidity to the finish cutting unit.

The spindle index mechanism is of the notched plate type and is operated by the generating roll through a crown gear and segment. It indexes the spindles at the roughing and finishing stations at the same time. Each spindle is provided with an easily changed notched index plate having the same number of notches as there are teeth in the pinion being cut.

Drive for the machine is accomplished by four separate motors. One 2-hp., 1800-r.p.m. motor drives the roughing cutter, another 2-hp., 1800-r.p.m. motor drives the finishing tools, a 1-hp., 1200-r.p.m. motor drives the turret index and a 5-hp., 1200-r.p.m. motor drives the feed of the roughing cutter, generating mechanism and the cutting oil pump. Chips from the roughing and finishing

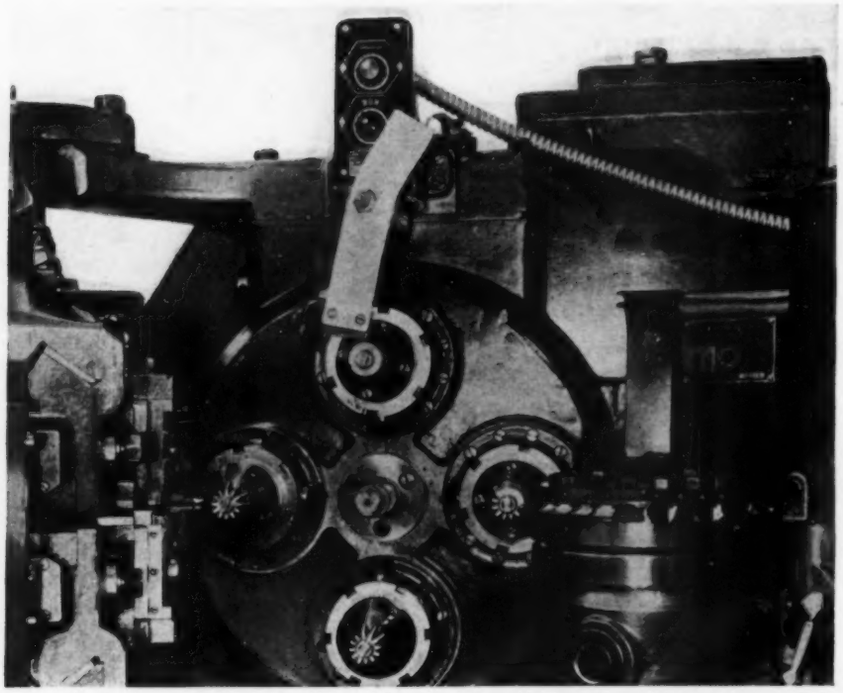


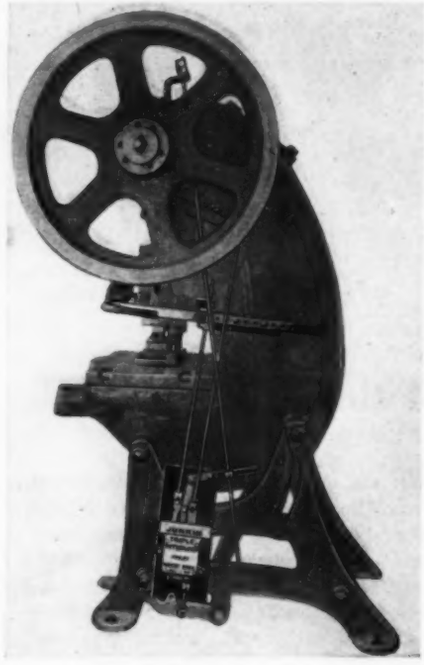
Fig. 2—Close-up of Gleason No. 9 Completing Generator, showing turret, inserted-blade roughing cutter at right, two reciprocating finishing cutters at left

operations drop into a large pan, which is readily accessible for cleaning.

Specifications: Capacity, longest cone distance, 3 in.; shortest inside cone distance, ⅜ in.; largest pitch angle, 38 deg., 40 min.; smallest pitch angle, 26 deg., 34 min.; extreme ratio, 1.25 to 1 or 2 to 1; largest pitch diameter, 2 to 1 ratio — 2.750 in.; 1.25 to 1 ratio, 3.750 in.; largest pitch, 4; longest face, 1⅛ in.; index range (number of teeth), 8 to 18; tool strokes per min., 300 to 550; cutter speed —5 changes—38 to 74 r.p.m., 104 to 202 ft. per min.; feed (time per tooth), 3.9 to 11.3 sec.; floor space, 65x96 in.; net weight, 17,000 lb.

"Junkin" Triple Interlock Safety Guard

Placed on the market by Wuest Bros., 10th & Hill Sts., Louisville, Ky., is the "Junkin" triple-interlock safety guard for presses. When the pedal is depressed, the guard, which is light and cushioned so that it will not injure the operator's hand, is automatically unlocked and falls by gravity. If the operator has his hand in the way, preventing the guard from coming all the way down, the pedal will lock and the press will not be tripped. With this device the operation of the guard is 180 deg. ahead of the ram and the guard must be all the way down before the ram starts down and the guard starts up. At each operation, the pedal rod is automatically brought back to the locked position and, at the same time,



the clutch dog on the press itself is brought back into a release position and the press cannot repeat its operation unless the guard has dropped into a safe position. If the operator fails to remove his foot from the press pedal the guard will drop ahead of the press. Thus, the operator cannot ride the pedal, which is claimed to cause 75 per cent of accidents. When a die that does not require automatic guarding is put in the press, it is only necessary to release a setscrew.

"Multi-Jarvis" Flexible-Shaft Machine

Announced by The Charles L. Jarvis Co., Gildersleeve, Conn., is the "Multi-Jarvis" flexible-shaft machine, which is available in several styles. That illustrated is the Type FJA bench model, but an overhead trolley Type FJC and roller floor-stand Type FJB may be had. The motor used is a ½-hp., ball bearing, repulsion-induction type, and drive is through a ball bearing, self-tightening countershaft. Speeds are 1,000, 2,000, 4,000 and 7,000 r.p.m. Flexible shaft is ⅜ in., 42 in. long, but longer shafts can be had.

"Ryertex" Synthetic Resin Bearing

Joseph T. Ryerson & Son, Inc., P. O. Box U, Chicago, Ill., has announced a bearing made from synthetic resin and with textile material as the base. The bearing cannot be re-softened by heat, will not absorb water or oil and is resistant to most acids. It is, however, attacked by hot caustic alkalies. "Ryertex" shows a Brinell reading of about 30-40 and a Sclerescope reading of 70-80. It is claimed that the bearing will outlast babbitt and bronze. It is satisfactory in cases where it is easier to apply water as a lubricant than oil, although the bearing will operate satisfactorily with oil.

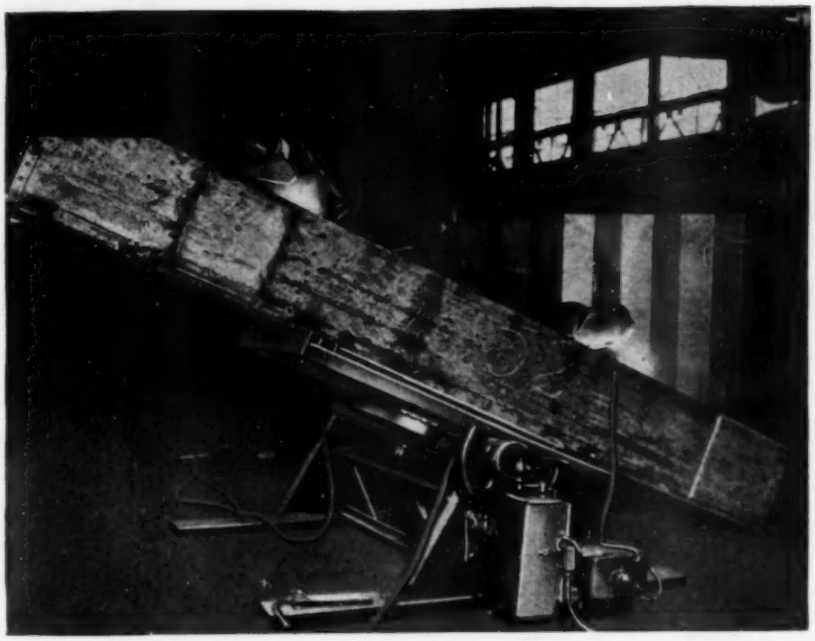


Fig. 1—Harnischfeger Type T Position Finder for work of irregular dimensions

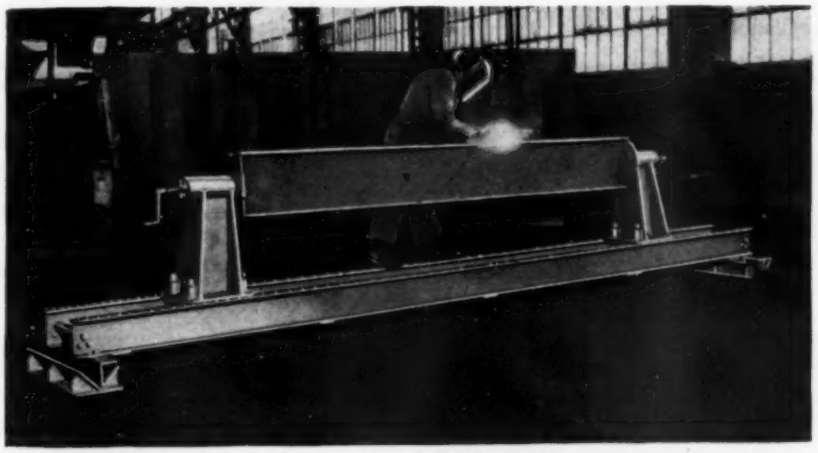
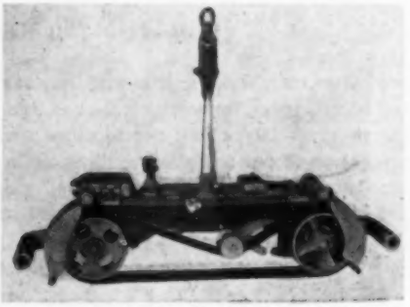


Fig. 2—Harnischfeger Type L Position Finder for long, narrow structures

Harnischfeger Position Finders for Welding

Studies made by a consulting welding specialist reveal that an average of four man hours are exerted in handling material for every man hour of actual welding time. A step in minimizing handling time has been made by the Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis., in developing two types of position finders or welding fixtures. The Type T position finder, illustrated in Fig. 1, is suitable for handling one- and two-side work on structures of irregular dimensions. After the material has been tacked down to the renewable top supports it can be tilted into any desired welding position. Complete table assembly, including the rotating track, is mounted on trunnions and provided with a motor-operated self-locking worm and worm gear drive for tilting in either direction through an arc of 60 deg. This permits bringing the pieces to be welded into such a position that the metal can be deposited in a horizontal trough. The two members being welded are normally placed in a position 45 deg. with the vertical. Two sizes of this position finder are built. Top dimensions of both tables of 6 ft. by 3 ft. 6 in. Model T-4 has a capacity of 4,000 lb., and the weight of this size is 2,300 lb. Model T-8 has a capacity of 8,000 lb., and its weight is 2,700 lb. Adjustable top extensions can be supplied for both sizes.

The Type L position finder, Fig. 2, supplements the table models. Long narrow structures, requiring welds on four sides, can be handled on this type of fixture. Headstocks are readily adjustable to accommodate structures ranging from 1 to 16 ft. in length. Each headstock carries a screw-operated spindle. Work can be set up quickly between the spindles and rotated on its longitudinal axis through 360 deg. The front spindle is provided with an index plate and locking pin to permit spacing at 2 deg. intervals.



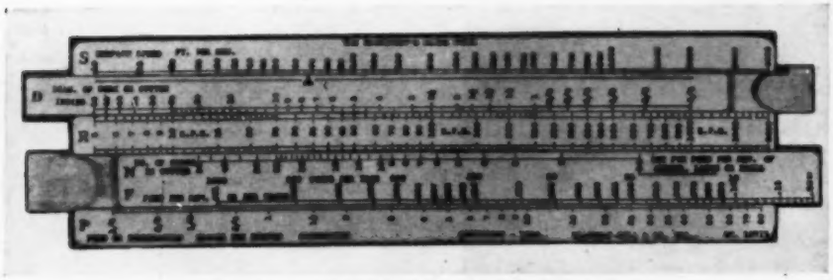
Buckeye High-Frequency Portable Tools

The Buckeye Portable Tool Co., Dayton, Ohio, is introducing several high-frequency electric portable tools. A special high-frequency motor is being used. The high-frequency belt sander, Model No. 352-E, features a single motor drive. Used for smoothing down welds, smoothing up large steel dies, finishing metal, wood and stone surfaces, it is operated by one man, and is suspended over the job by a cable. The sander is cooled by compressed air, which is also used for the automatic belt tension device. Belts used are 2¾ in. x 5½ in. By the use of a belt idler it is possible to use manufactured abrasive belts over an endless leather belt. The speed is 4,500 r.p.m.

The high-frequency motor is also being used in the "Hercules" cup wheel grinder, Model No. 382-E. This grinder is used on weld seams, and for surfacing large castings, as well as for grinding dies and flat metal.

Blackman-Hill Machinist's Slide Rule

A shop calculator called "The Machinist's Slide Rule," as illustrated, has been developed and put on the market by Blackman-Hill & Co., Inc., 1513 N. Broadway, St. Louis, Mo. This pocket-



Blackman-Hill Machinist's Slide Rule

size slide rule, 7x2x¼ in., will indicate the proper speed for work, drill or cutter, the proper relative feed per tooth or per revolution or per minute in milling, drilling, turning and boring operations, and will tell in advance the approximate power required for a given speed, feed and cut based on the cu.in. per minute of metal removal. The rule consists of ten graduated celluloid scales mounted on a box-wood rule with four dovetail slides.

Schiess-Defries Milling Machine Weighs 350 Tons

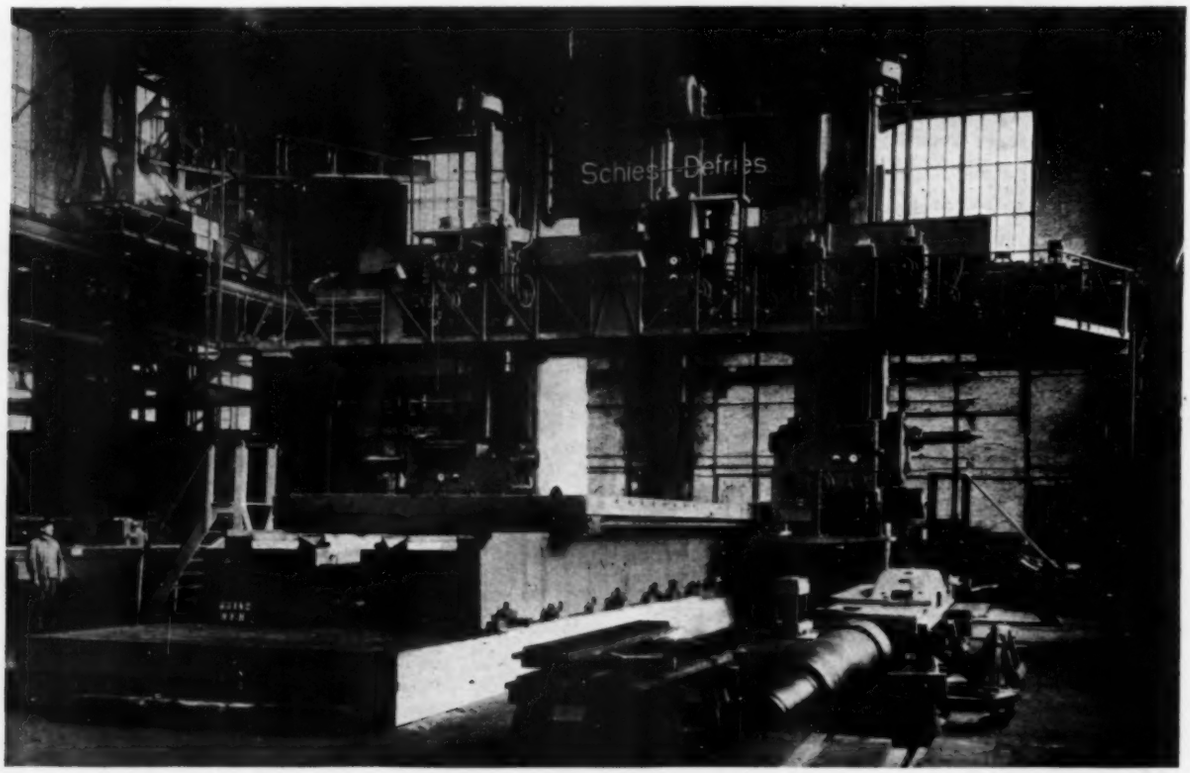
Another concern which has just finished a rail-type milling machine of great size is Schiess-Defries, Dusseldorf, Germany. The American agent is U. Kauermann, Fountain Square Bldg., Cincinnati, Ohio. In this case the machine weighs 350 tons, and is capable of taking work up to 16 ft. wide by 16½ ft. high. It has four heavy milling heads, each with two separate motors, one for drive and one for quick movement and feed. These milling heads are entirely independent. A large number of milling speeds and feeds and also boring feeds is provided. Furthermore, the machine is equipped with two planing tools. Both planing tools are independent of each other for feed and high-speed movement. For planing, the table is driven by a variable-speed reversible motor controlled by a "Leonard" converter.

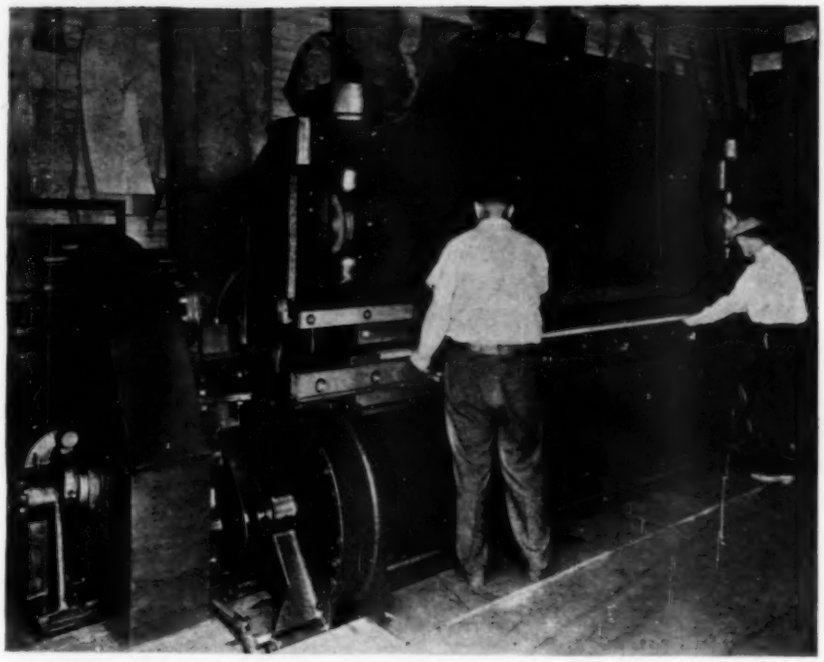
For milling, the drive of the table is actuated by a spindle and separate motor. Also for the table there are arranged a large number of milling feeds and quick movements. With the aid of a remote push-button control, the operator can control every movement of the machine from six different panel stations. By moving a few levers, the milling machine is converted into a planer. Ammeters, speedometers for feed and rapid traverse movements and instruments for the indication of the pressure oil system are arranged on all service stations of the machine.

Rafter Press Brake of Welded Steel Construction

Welded construction is now used for the deep ram and bed of the Rafter press brake built by Farrel-Birmingham Co., Inc., Ansonia, Conn. The bed is made of rolled steel plate, welded into a girder section. Gear casings and housings for eccentric and gear shaft bearings are welded integrally with the bed. All welded steel parts are annealed and normalized after welding and before machining to remove stresses occasioned by rolling or welding.

The ram is a solid rolled steel plate. Adjusting screw housings, guide bosses and other parts are formed by welding, and the ram is annealed and normalized the same as the bed. There is no driving mechanism on the upper part of the machine; it is attached to or contained within the bed. Over-all height is thus shortened and less headroom is neces-





Rafter 100-Ton, 10-Ft. Press Brake with welded steel bed and ram as installed in a Pacific Coast shop

sary. The feature of operation is that the ram is pulled from below instead of pushing it from above. Power is transmitted from the driving motor to the flywheel on the drive shaft through multiple V-belts and a friction clutch. Cut tooth gears inclosed in oil-tight casings connect the drive and intermediate shafts with individual eccentrics at each end.

Sundstrand Set-Ups for Aluminum Pistons

Two set-ups were recently furnished by the Sunstrand Machine Tool Co. for operation on aluminum pistons. Fig. 1 illustrates the No. 3B vertical rotary Rigidmil with a 24 in. rotary table and 26½ in. diameter table top equipped with twelve independent interchangeable work-holding fixtures for the operation of machining the diagonal slot on aluminum pistons. Simultaneous with the machining operation, a spring-loaded hammer mechanism automatically stamps the word "front" on the head of the pistons as the work revolves. An 8x$\frac{7}{64}$x1 in. high-speed slitting saw is used. Production per hour, 1,600 pieces.

Fig. 2 shows a No. 3B machine equipped with a 2-spindle head and a 24-in. rotary table, and also with an auxiliary drum cam unit to oscillate the table $\frac{7}{8}$ in., timed for 10 oscillations per revolution of the table. The operation is to mill the radius at the open end of the piston and to saw a slot in the third piston ring groove. For this operation ten independent and interchangeable fixtures are used in connection a special two-spindle milling head.

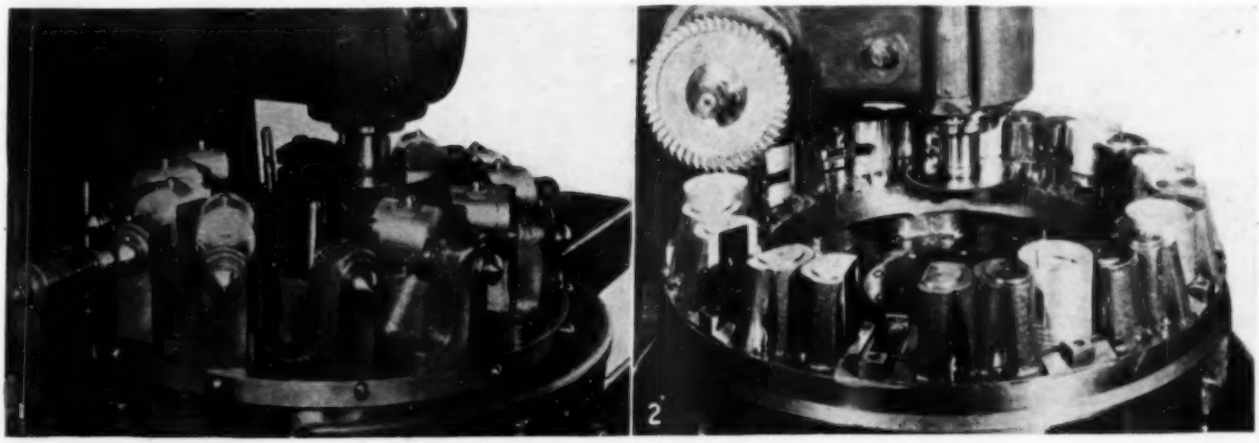
The piston is brought to the machine with the outside diameter turned and grooved, with the head faced, the wrist pin holes bored and the diagonal slot sawed. The piston is loaded into the fixture with the close end of the piston resting on steel locating plates. The piston is then clamped automatically by means of two cam-operated spring-loaded sliding fingers gripping in the wrist pin holes.

The radius is formed in the skirt end of the piston by the cutter on the horizontal spindle, and the $\frac{7}{64}$-in. saw slot is machined by means of the cutter on the vertical spindle.

In the two-spindle head the horizontal spindle is mounted in an eccentric quill with eccentricity of $\frac{7}{8}$ in. In order to mill the slot in the proper location in the piston, it was necessary that the gash method of milling be performed, whereas to machine the radius on the skirt end of the piston, it was necessary to use the continuous rotating method of milling. Therefore, by the adoption of the oscillating table both methods of milling were accomplished simultaneously. The cutters are so arranged and the table is so timed that the oscillating motion takes place at the point where the radius milling cutter is between two pistons. Therefore the oscillating movement has no effect on the radius milling. Production per hour, 900 pieces.

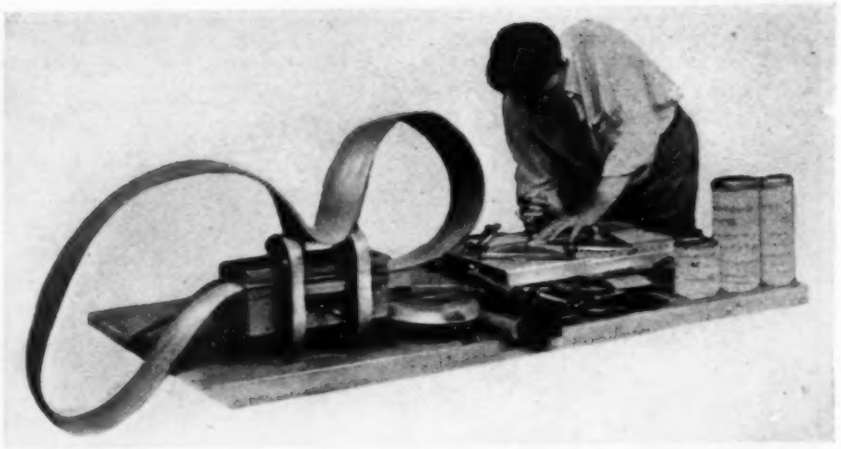
Udylite Ball Anode Container

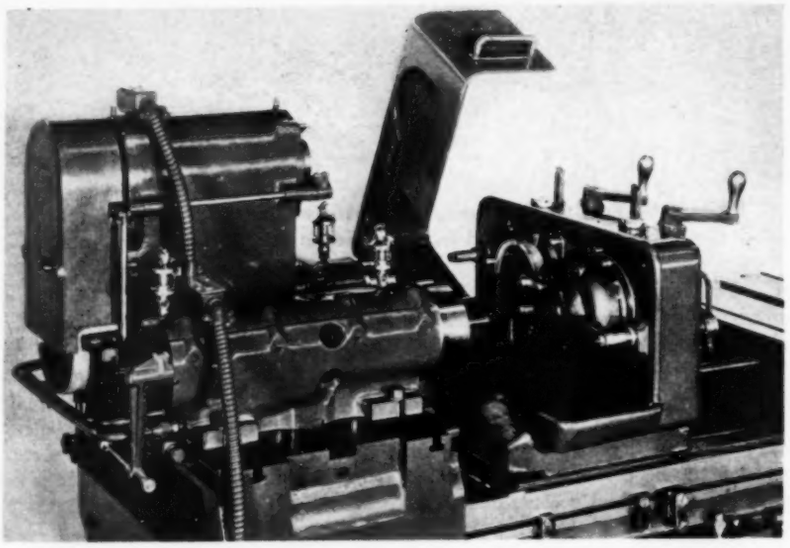
Udylite Process Co., Detroit, Mich., has received a patent on a cadmium ball anode helical coil container. The basket or container comprises a wire helix, and the convolutions are fairly widely spaced at the top but they approach close together at the bottom so that the anode balls as they grow smaller will not fall out. In this way new ball anodes may be added from time to time, and assurance is given that none of the material will drop out of the container.



Goodrich "Highflex Junior" Transmission Belting

For some plants it has been necessary that rubber belts be made endless after being applied to the machine on which they are called upon to operate, and it has been impossible to install factory-made endless belts. Now, The B. F. Goodrich Co., Akron, Ohio, announces a belt named "Highflex Junior" and a simple inexpensive outfit which enables plants to make their own endless belts. The belting is built up of a number of plies of a specially woven fabric designed to give the proper characteristics when spliced endless on the machine. This "Highflex Junior" is not similar to "Highflex" transmission belting announced several years ago. Highflex Junior is made in widths 6 in. and under. A special cement and tie gum are necessary for making the splice. A low-priced, electrically heated, automatically controlled portable electric vulcanizer has been developed for use with the belt by the James C. Heintz Co., Cleveland. A light templet for laying out and stepping down the ends of the belt so a perfect fit can be obtained, along with the necessary hand tools, completes the equipment. It is portable.





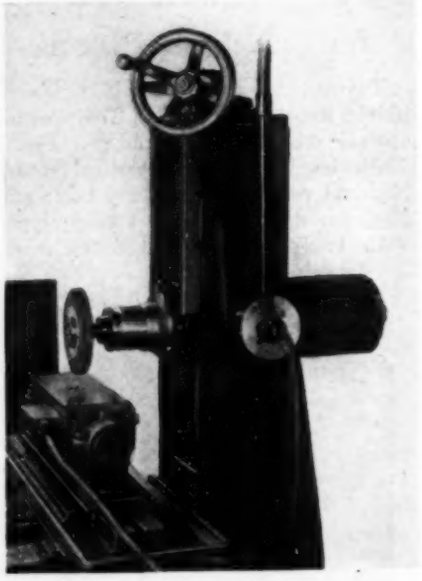
Ex-Cell-O No. 216 Finish Boring Machine Adapted to Timing Gears and Motor End Frames

Illustrated is a close-up view of the motor boring units and holding fixture used on an Ex-Cell-O precision boring machine, Style No. 216, that was designed for finish boring either a 7/8-in. or a 2 5/8-in. hole in steel hubs of Bakelite canvas timing gears and a 5/8-in. hole in motor end frames. The machine was supplied by the Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich.

Two types of motor-driven boring units are used in this application. The boring unit at the back has a separate standard motor mounted in the same bracket as the boring spindle, and the two units are connected by a belt. The boring unit in front has a self-contained built-in standard motor mounted directly on the same shaft as the boring spindle.

The holding fixture is a two-station type, and the cover is in the open position to show a timing gear and motor end frame in position. At the back of the fixture the timing gears are bored. They are located from the outside diameter by locating rings and clamped against one face. Adapters are furnished so that the two gears are interchangeable in the same fixture. Because of the difference in diameters of the two gears it is necessary to change the boring spindle speed. This is accomplished by reversing the pulleys used on the motor and boring unit.

The fixture is so designed that the motor end frames and the Bakelite canvas timing gear with a 7/8-in. hole can be bored in the same operation. Gross production on these parts is approximately 112 pieces per hour. When boring the 2 5/8 in. hole, the production is approximately 72 gears per hour.



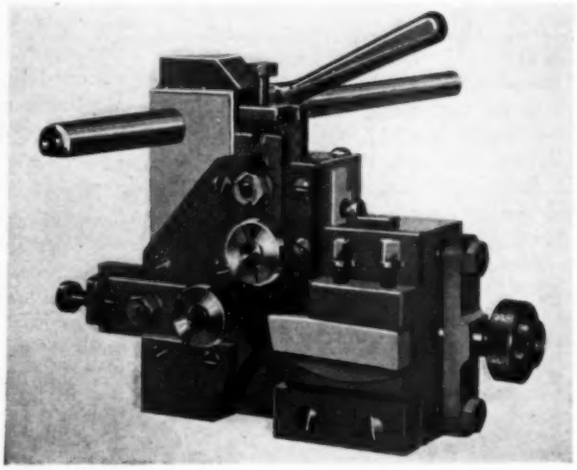
Parker Motor-Driven Grinding Spindle for B&S No. 2 Surface Grinder

The Majestic Tool & Mfg. Co., 2650 Poplar St., Detroit, Mich., has developed a direct motor-driven spindle for the No. 2 Brown & Sharpe surface grinder. This spindle, being driven with a 3/4-hp. motor at 3,450 r.p.m. under full load, is suitable for grinding splines, slots, keyways and grooves. There is claimed to be no end play in the spindle

so that the operator's attention may be concentrated entirely on the grinding instead of nursing the spindle along. To adopt this type spindle to the standard spindle housing requires only reboring the housing to a diameter of 3 in., drilling and tapping a ⅜-in setscrew hole in the lower part of the housing face and spotting the spindle for the setscrew.

Prydz Universal Roller Taper Turner

Tapered bolts and pins up to 2½ in. are produced by the universal roller taper turner placed on the market by the Prydz-Ziegler Manufacturing Company, 915 Washington Ave., South, Minneapolis, Minn. Besides railroad shops it is of use in general manufacturing plants. An attachment has also been developed for boring internal tapers. The cutting tool on this machine is regulated by the taper governor (long bar at the top of the machine), which is round and has a flat taper on the one side. Travel of the taper turner on the turret lathe slides the governor bar through the body of the machine, producing the required taper. The roller backrests hold the material firmly against the pressure of the cutting tool. To change the amount of taper it is necessary only to change the governor bar. The size of the cut this machine will take is the same as any cutting tool on a turret lathe. The only adjustment necessary is to size. The device can be used for both straight and tapered bolts without changing tools. It is only necessary to move the stop back out of the way of the governor rod to produce straight work.



Jarvis Screwdriver and Nut Setter

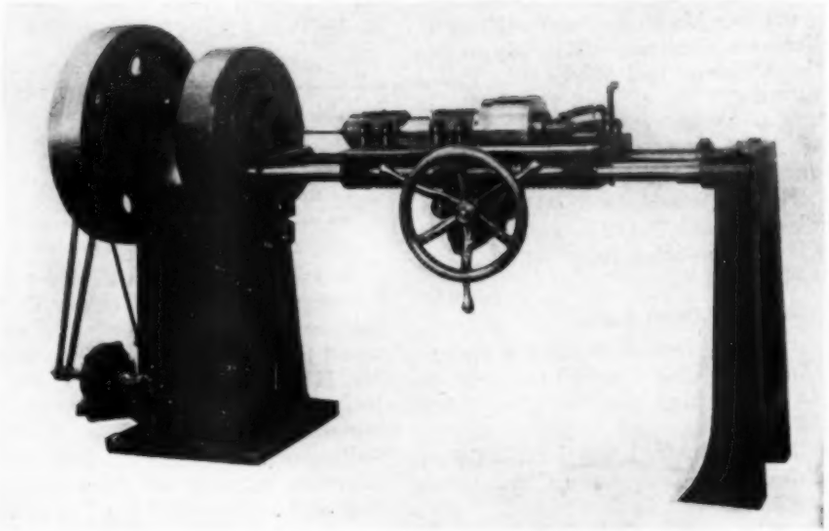
Driving screws and setting nuts up to ¼ in. is the capacity of the Jarvis setter announced by The Charles L. Jarvis Co., Gildersleeve, Conn. The tool is of the flexible-shaft type and will drive screws or nuts with uniform tension, but the tension is adjustable if desired. It is equipped with the "Niedhammer" type clutch. Specifications are as follows: Motor ¼ hp., ball bearing, 1750 r.p.m.; flexible shaft, ⅜ in., 36 in. long, interlocked-type metallic casing with flat steel inner lining; hand piece, double ball bearing; clutch, mechanical, double-ball type, adjustable to required tension; capacity, up to and including ¼ in. screws, nuts or bolts; production, 15,000 screws, ¼ in. x 1½ in. long, driven in hard wood, in 8 hr.

E-Z-Draft Sketch Pad

McCauley & Madison, Inc., Detroit, Mich., is marketing a designer's sketch pad which combines a durable artificial leather cover, a 100-sheet pad of special transparent paper, and ruled bristol board plates to be inserted under the top sheet of the paper. One plate is ruled isometrically on one side, and in standard ⅛-in. cross-section on the other, either side having horizontal and vertical lines at 1-in. intervals. On the isometric side there are two other series of parallel lines running to the right and left, these lines being sloped at an angle of 30-deg. The perspective plate is designed in the same size with lines running vertically, which diminish in space to the right and left.

Langelier Swaging Machine for Valve Blanks

For reducing valve blanks before upsetting in order to eliminate turning, the Langelier Mfg. Co., Providence, R. I., has supplied a Type "E" swaging machine constructed with four dies. It is equipped with a handwheel-operated rack and pinion feeding mechanism, having an automatic air chuck to grip the work on the forward movement of the saddle and release it automatically



at the end of the feed stroke. To insure sufficient power and easy feeding, compound gears are interposed between the handwheel and pinion shafts. Tendency toward twisting of hot stock during swaging is minimized, since the chuck is allowed to rotate in split bearings, friction being applied to control the speed of rotation. Interchangeable collets are used so that any size of blank up to the capacity of the machine can be swaged. The tooling furnished will handle the reducing of $\frac{31}{32}$ in. diameter valve steel blanks, to $\frac{23}{32}$ in. in one hot swaging operation. Any length up to 20 in. can be swaged.

• PATENTS •

SEPTEMBER 20, 1932

Metal-Working Machinery

Milling Machine. Sol Einstein and Lester F. Nenninger, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,877,828.

Honing Machine. Albert M. Johnson, Rockford, Ill., assigned to Barnes Drill Co. Patent 1,877,881.

Die Casting Machine. Torbjorn C. Korsmo, Madison, Wis., assigned to Madison-Kipp Corp. Patent 1,877,896.

Lathe with Center Drive. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,877,922.

Ring Grinding Machine. Fritz Deutsch, Germantown, Tenn., assigned to Lehmann Machine Co. Patent 1,878,116.

Crank Shaft Lathe. William F. Groene, Cincinnati, Ohio, assigned to the R. K. Le Blond Machine Tool Co. Patent 1,878,131.

Automatic Lathe. William F. Groene, Cincinnati, Ohio, assigned to the R. K. Le Blond Machine Tool Co. Patent 1,878,495.

Lapping Machine (Gear). Albert E. Robinson, Cincinnati, Ohio, assigned to the American Tool Works Co. Patent 1,878,603.

Slide Mounting for Lathes. William H. Foster, Elkhart, Ind. Patent 1,878,628.

Hobbing Machine. Frank H. Adams, Cleveland Heights, Ohio, assigned to the Cleveland Hobbing Machine Co. Patent 1,878,656.

Tools and Attachments

Chucking Device. William F. Groene, Cincinnati, Ohio, assigned to the R. K. Le Blond Machine Tool Co. Patent 1,878,130.

Boring Tool for Internal Taper Boring. Erling Oyen, Youngstown, Ohio. Patent 1,878,175.

SEPTEMBER 27, 1932

Metal-Working Machinery

Gear Cutting Apparatus. Linus E. Greene, Fitchburg, Mass., assigned to Manning, Maxwell & Moore, Inc. Patent 1,879,196.

Cam Shaft Lathe. William F. Groene, Cincinnati, Ohio, assigned to the R. K. Le Blond Machine Tool Co. Patent 1,879,201.

Automatic Control of Feeding Mechanism in Tool Machines. Alfred V. Mershon, Schenectady, N. Y., assigned to General Electric Co. Patent 1,879,388.

Grinding Machine. Louis L. Roberts, Detroit, Mich., assigned to Packard Motor Car Co. Patent 1,879,506.

Metal Working Press. Fredrich J. Rode, Chicago, Ill. Patent 1,879,510.

Machine Tool. Bernard P. Schiltz, Cleveland, Ohio, assigned to the Foote-Burt Co. Patent 1,879,531.

Machine Tool. Edward J. Kearney and Joseph B. Armitage, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,879,692.

Tools and Attachments

Cylindrical Grinding Attachment for Surface Grinders. Warner L. Dolph and Norman H. Lewis, Rochester, N. Y. Patent 1,879,134.

Gage for Sizing Internal Threads. George E. Mirfield, Youngstown, Ohio. Patent 1,879,398.

Indexing Means for Grinding Milling Cutters. George E. Mirfield, Youngstown, Ohio. Patent 1,879,399.

Metal Working Tool. William C. Sproul, Rockford, Ill., assigned to the Ingersoll Milling Machine Co. Patent 1,879,574.

Chuck. Robert S. Brown, New Britain, Conn., assigned to the New Britain-Gridley Machine Co. Patent 1,879,656.

Processes

Means for Milling Surfaces Requiring a Uniform Screw Pitch. John W. Smith, Phila., Pa. Patent 1,879,566.

• TRADE •

PUBLICATIONS

BORING MACHINES. R. Y. Ferner Co., Investment Bldg., Washington, D. C., has issued a bulletin describing the latest model Swiss high-speed precision borer, No. MP-3C. The catalog is known as No. 534-A, and is issued by Société Genevoise d'Instruments de Physique, Switzerland. The borer has capacity for 14x20x14 in., and will bore holes as large as 4 in. or as small as a No. 60 drill.

HARDNESS TESTING INSTRUMENTS. R. Y. Ferner Co., Investment Bldg.., Washington, D. C. has issued a list of 13 publications on various phases of the use of its line of portable hardness testing instruments. Bulletin H-4 is the catalog of the regular line. Other bulletins and their subjects are as follows: Bulletin H-2 discusses the use of the Duroskop in the hardening of steel; H-3 covers conversion curves for converting Duroskop readings to hardness numbers of the Brinell, Rockwell and Scleroscope systems; H-6 describes a Dwarf Brinell press now available, which is adapted to testing of soft metals; H-8 discusses the use of Triplex sets for testing of cast-iron surfaces of lathe or planer beds while being machined; H-12 discusses the use of the Duroskop in checking the hardness of cylinders and rolls while in the process of manufacture; and H-14 describes tests on thin sheet metal.

HOIST MOTORS. General Electric Co., Schenectady, N. Y., has issued Bulletin GEA-1366 on Type KR, small a.c. hoist motors of the totally inclosed design.

LIGHTING EQUIPMENT. Catalog 219-A describes Westinghouse industrial lighting equipment and lists them in a manner easy to find. Copies may be obtained direct from district offices of Westinghouse Electric & Mfg. Co., or from the Advertising Department, East Pittsburgh, Pa.

PAINTS. The B. F. Goodrich Rubber Co., Akron, Ohio, has prepared a bulletin on "Acidseal Paints" which contain rubber derivatives that minimize the corrosive action of acids and alkalies on materials. The several different types are suitable for industrial use.

SCALES. The Kron Co., Bridgeport, Conn., is now distributing a new bulletin describing its completely redesigned line of automatic industrial scales. Included in the line are dial track scales, portable pan, portable platform, dormant platform, bench, hopper, crane and pitless suspension types.

STANDARDS YEARBOOK. The U. S. Department of Commerce, Bureau of Standards, has published the "Standards Yearbook, 1932," which includes summaries of important national and international standardization activities and accomplishments of the Government standardizing laboratories of England, France, Germany, Canada, Japan, and of the Bureau of Standards of the United States. Another chapter is devoted to standardization activities of American technical societies and trade associations. The book contains 400 pages, and is bound in blue buckram. It is known as Miscellaneous Publication No. 133, and the price is $1.00 for domestic sales.